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THE ANCESTRY OF NASUA.[1]

BY SAMUEL LOCKWOOD, PH.D.

AFTER a chronicle of such achievements of Coati-Mondi and her Cousin "Coon," shall we not institute a serious search into the origin of the heroine, and so establish or set aside our suspicion? "So I should think," says an interested reader, "after such a tidbit of revelry in the romance of science-dom or dream-land." So, ho! a challenge to the array! Then let the contest come! But pray, good sir, is there not in this realm of science an imagination which conducts to light and truth, as against that romance which leads surely to error and darkness? But what is scientific romancing? Is it not that unscientific conduct which, as if contributing to knowledge, asserts the untenable and untruthful? Sometimes the conceit is so unwarranted as to appear on its very face a vagary, extravagant and impossible.

Science thinking is reverend and reserved—for here dash is impudence, nor is cheek courage. The habitual theorist finds a fascination in sheer novelty—of such the cautious thinker is chary. But if the giddy and reckless are proscribed the use of edge tools, the sober-minded is allowed the tentative hypothesis. The one would cut the knot, the other would untie it. The honest theorist is simply feeling his way. He may have *a priori* methods despite of Mr. Gradgrind's much mouthing for "facts!" Such modest ventures, "assumptions," may prove real forecasts of wide significance. But such is not romancing. Nature has her seers, who have happily uttered esoteric truth which has afterwards crystallized into accepted theory in the formulation

[1] From a forthcoming work by Dr. Lockwood.

given it by the setting of the factors denominated "facts." So it was with Germany's great poet. But here comes a nice distinction between the condemnable and the commendable, between romancing in science and the scientific imagination. Goethe's guesses were neither blunders nor vagaries. His theory of the genesis of the flower, of the vertebrate origin of the skull, and his forecast of the doctrine of descent, were all marvelous births, but legitimately begotten, the offspring of pure scientific imagination. As in advance of the thought then in vogue, they seemed prematurely brought into the light, and for a time were nurslings of unpromising vitality.

But a truth thus evolved finds no similitude in the spark struck out by flint and steel. Nor is such truth premature, as to its ratiocination, as would appear could we but time its gestation. I think it is always the outcome of "unconscious cerebration." The mind of the seer has been deeply thinking on generic lines. As first expressed such a truth may be ore-like—rich, but crude—and it may have to wait for the facts which shall serve as faggots for the crucible.

Having in the article "Coati-Mondi and its Cousins," with perhaps seeming insufficient warrant, asserted for Nasua a quadrumanous kinship, now that the faggots have been got in plenty, why not smelt the ore? Or, dropping metaphors, let us go in direct quest of Nasua's ancestry, even its biogenesis, upon reasoning lines.

In tracing the pedigree of some regal line, perhaps we should reach a very ancient Norman stirp. But however ancient, it would be the Norman of civilization, not his savage progenitor of the Palæolithic age. This would be as far up the stream of the past as we could sail. So with our Nasua, we must stop at the origin of the Educabilia, the quasi intelligent animals, those namely which have the cerebrum or frontal brain relatively large and roofing, or overlapping the cerebellum or small hinder brain.

1. First then, as to that quadrumanous alliance of Coati; on what line of reasoning may the genealogy be traced? My first impression of this fact came to me as a conviction of the imagination. I did not then, it is so long ago, know anything of the modern doctrine of "unconscious cerebration." I had so studied the living animal as to fairly know its ways, and I came to suspect, as an inheritance, the monkey strain, as the breeders would

say. I could see the traits but could not demonstrate them. At best I could but quote the great poet:

> "Such seething brains,
> Such shaping fantasies, that apprehend
> More than cool reason ever comprehends."

2. That which backed up the imagination was the psychological or mental manifestation. Here were data for comparison, in such well-marked lines ran the parallels of expression of the Nasuan and the monkey mind. The hints afforded in the complex use made of the hands and the tail—the many unmistakable monkey didos, or antics, which came not of training nor of aping, but of real generic aptitudes. These all pointed to a physical correspondence, and looked directly to ancestral inheritance.

3. I think it was in 1873, the year after the appearance of my article, that an interesting anatomical discovery was announced by the great academician, the successor of Cuvier, Henri Milne-Edwards. He had dissected a Nasua and had discovered in the limb bones of this animal structural alliances to the lemurs, or lowest monkeys. Here was, indeed, a pleasant and important confirmatory fact.

4. But to round up the proof, one more class of evidence is needed, the testimony of palæontology. In behalf of the extinct animals will the fossils bear witness in this matter? The writer was instructor in the natural sciences in the grammar school or preparatory department of Rutgers College, when he received from its author a pamphlet "On the principal types of the orders of Mammalia Educabilia," by Professor E. D. Cope; read before the American Philosophical Society, April 18, 1873. My eyes caught a foot-note to one of the pages, thus: "Dr. Lockwood, of Rutgers College, in a recent number of the *Popular Science Monthly*, expressed serious suspicions of the quadrumanous relationships of the Coati, little thinking at the time that the specimens to confirm his view were at that moment in the hands of palæontologists."

Let us now take down this testimony from nature's own mouth. Certain fossil bones had been found in the Eocene formation of Wyoming. Previous to the Eocene period of time the fauna of this world's life-history had consisted of animals of a very low grade on the mammalian lines. Technically they are classed as the Ineducabilia. In the Eocene days the creative force was exercised on higher lines of life. Then were produced the real

ancestors of those animals which are included in the zoölogical term Educabilia, whose cerebral physiology has been already explained. As notable genera of those days I may mention the pseudo-bear—Notharctus of Leidy, and the cut-tooth beast—Tomitherium of Cope. Others there were by Marsh, but their descriptions are not in my reach. Leidy's species, *Notharctus tenebrosus*, described from very limited material, was a little animal about two-thirds the size of a raccoon. Cope's species, *Tomitherium rostratum*, founded on a much larger amount of material, was an animal probably about the size of *Cebus capucinus*, the prehensile-tailed monkey so common in shows. Upon technical considerations both these animals, albeit their strange and high-sounding scientific names, were low-grade monkeys. They were quadrumanous animals but of a synthetic, that is, comprehensive type. The femur of Tomitherium was so long as to indicate that the knee was entirely free from the body, as it is in the whole monkey tribe of to-day, but never in any of the carnivores. The round head of the radius indicates a complete power of supination of the fore feet; that is, the ability to lift the hand, so to speak, forward and to turn the palm upward, a faculty of limb peculiar to monkeys and man, while the distal or lower end of the same bone resembles closely that of Semnopithecus, a high-grade old-world monkey. "We have then," continues Cope, whom we are epitomizing, "an animal with a long thigh free from the body, a foot capable of complete pronation and supination, and a form of lower jaw and teeth quite similar to that of the lower monkeys."

And in this connection what about our Coati? Says the professor: "A comparison with Nasua reveals no distant affinity. The fore limb presented in Tomitherium a great similarity to that of Nasua." And in both genera are some striking similarities in the cutting teeth. "The first impression derived from the appearance of the lower jaw, and the dentition, and from the humerus, is that Tomitherium is an ally of Coati, the humerus being almost a *facsimile*." And is it not a striking coincidence that Professor Leidy's first impression of Notharctus was of a resemblance to Procyon, the raccoon, which, as we have shown, is generic with Nasua.

It is evident then that Tomitherium and Nasua show some alliances in structure which look to a common origin or biogenesis, but it is a descent on different lines. From his study of an

immense amount of fossil relics from the same geological formation which yielded Tomitherium, Professor Cope has erected the order Taxeopoda, which includes these fossil lemurine forms. This order occupies the earliest section of the line of the Primates. First in these fossil forms come the Lemuroids at the base of the Primate lineage. After these extinct forms appear the true Lemuroidea, that is, the present or living Lemurs, followed by the monkey proper, and these by the anthropoid apes. Now, among the lemurine forms, and fairly started on the quadrumanal line of descent from the typical lemurine order Taxeopoda, occurs Phenacodus, after which Tomitherium appears somewhat farther advanced on this Primate line.

Now, on an off-line or branch from the lemurine Taxeopoda, starts the flesh-eating line; first the Creodonta, the "slaughter-teeth," then the Carnivora proper, with the present living forms. Cercoleptes connects Nasua to the extinct Creodonta, and through these back to the lemurine order Taxeopoda, their ancestral stock.

So we have at last found the Nasuan lineage and ancestry in the Eocene times. Phenacodus was an animal of a synthetic structure, a comprehensive type, from which flowed several ordinal streams of life. In such a composite form, or structural make-up, can we not surmise the creative possibilities and purposes of the Divine Mind?

It is an interesting fact that in a direct line one of Nasua's ancestors still exists in the same forests of South America. The kinkajou, *Cercoleptes caudivolvulus*, reduced to one species. When tamed it is an interesting little animal with amiable ways and monkey traits. The tail is prehensile in that it curls around an object, which with plantigrade feet give it in Germany the name curling-bear. Like the monkeys it will hold its food in one hand and break it and feed it to the mouth with the other. So then, kinkajou and Coati-Mondi come honestly by their monkey tricks, having a clear title by heritage.

Without turning homilist let me close by citing Ruskin and one of the great ancients: "The greatest thing a human soul ever does in this world is to see something." The Hebrew bard both sang and prayed: "Open thou mine eyes, that I may behold glorious things out of thy law!" And this biogenesis of Coati-Mondi, is it not one of the wonderful things—an outcome of Divine law?

THE MECHANICS OF SOARING.

BY I. LANCASTER.

IT was foreseen that the paper on the soaring birds in the November and December numbers of the NATURALIST of last year would provoke adverse criticism where it dealt with explanations of the movements of those creatures. The recognized laws of the mechanical forces being formulated from data derived from systems of which the earth is a part, makes it extremely difficult to deal with phenomena which are independent of that body, while still existing in its atmosphere.

There arises at every step taken to elucidate the matter, a seeming conflict with accepted laws, and however faultless the reasoning, it is discredited because of that apparent antagonism.

The word "soaring" is also a bad one to name the mechanical actions involved, as it implies a bird. No better, however, is at hand, and it denotes the method employed by the bird and not necessarily the creature itself, as it is here used.

While prosecuting the subject experiments of various kinds were conducted to dispel the obscurity which enveloped it, as careful observations had shown that it was completely different from any other kind of bird flight. Of almost half a hundred theories framed on postulates of bird or air, which were not true, *one* at length was found to be consistent with the facts. I suddenly found myself in the ludicrous predicament of industriously attempting to prove an axiom. My experiments became valueless. Time and means had been wasted. There already existed recognized data to make the whole case self-evident.

It is now more than five years since the discovery of the mechanical activities herewith detailed. During that time the matter has been made a study in all its bearings, so that mistaken conceptions might be avoided, and it is herewith presented to the mechanical world as worthy of serious attention.

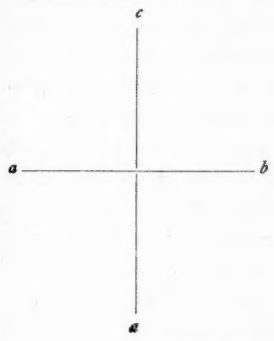
Technically, the material system of soaring is a flat surface, air, and a force. The gravitating force is not essential to it. Any force, a push with the hand, horse-power, steam-power or any other will fill the conditions. Neither is *atmospheric* air essential. The *air* must have the quality of great elasticity and offer considerable resistance to a moving body which compresses or drives it out of the way, and very little to the passage of a smooth, flat surface like a sheet of tin, edgeways in it. The force is then

applied to the body in such a way as to move it at right angles to the direction in which the force acts. This translation of the body is "soaring." It rests on two universally recognized laws. The most important is the conservation of energy, of which it is the most beautiful illustration to be found in mechanics. The other is the reaction in all directions of fluids under the action of mechanical forces.

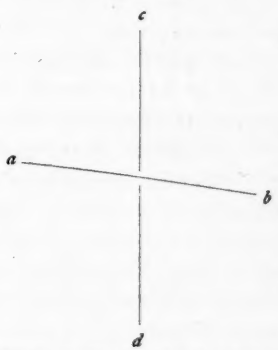
The body must be so constructed as to have at least two directions of motion which are unequally resisted by the air.

The case will be first presented as operating in space devoid of gravitation, where the body will have no weight, and afterwards the system will be introduced into the earth's atmosphere. Implications arising from the action of gravity, and the constant tendency to introduce the earth into the soaring system, will be avoided.

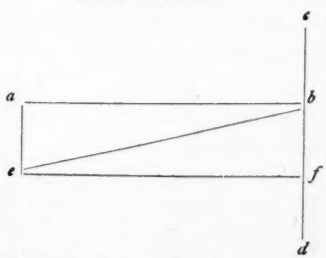
Suppose the body to be an oblong flat surface, such as a sheet of tin 12 × 72 inches, and that *a b* is its transverse section, and that the force moves from *c* towards *d*, at right angles to the sides of the surface.



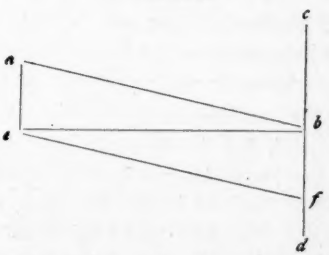
Surface at right angles to the direction of the force.



Surface inclined to the direction of the force.



Lateral motion of surface at right angles to the force.



Lateral motion of surface inclined to the force.

That the value of the force is twelve pounds moving the surface on the air with uniform velocity, which we will suppose to be five feet per second. Under these conditions it is obvious that all the force is employed in condensing and otherwise disturbing air, so that it is doing work on the air at the rate of twelve pounds each second. It is also obvious that while uniform velocity occurs there is a moving equilibrium between the surface acted on by the force and the reacting air, and that any additional force, however small, applied to the surface at any angle to its own plane would disturb this balance, and either accelerate or retard its velocity. If, however, the additional force be applied in its plane, lateral motion would occur without changing the equilibrium. In the lateral motion no air is disturbed, nor driven out of the way, nor condensed, excepting what is caused by smooth skin, or surface friction, and this is so very small as to elude all my attempts to find its value. One pound applied in the plane of the surface would doubtless drive it at the rate of 1000 feet per second. We will suppose, however, that one pound will drive it from *b* towards *a* at the rate of thirty feet per second. As it is moving towards *d* at the rate of five feet per second, it will pass neither towards *d* nor *a*, but on the diagonal *b e*, the resulting path, the parallelogram being thirty feet long and five feet wide.

Note the character of the equilibrium between the surface and air. The total force is flowing around the edges of the surface in the shape of condensed and otherwise disturbed air. If the hand were placed under the surface with an upward push, precisely as much resistance as would be *given to* the hand would be *taken from* the air, and the velocity retarded. If scales were applied to the surface and a pull towards *c* given, part of the force would be moving the index and precisely that much less would be working on air, and the velocity of the surface would be again retarded. If the surface met with sufficient impediment to stop its motion, *all* the force would be resisting the impediment and *none* doing work on air, and velocity would cease.

It is evident that at uniform velocity the force has been transferred. It is in the air tension, and not in the surface, for to be also there, would necessitate its creation out of nothing. There being then, no force in the surface, it could not antagonize any resistance offered to it, and this is in fact its condition as we have seen. While its velocity remained uniform it would obey any impulse

derived from incident forces directed upon it, being powerless to resist them.

So far all is evident, but the surface would not fill the conditions of soaring. Its motion is not at right angles to the force, but inclined thereto, and to accomplish the desired result its path must be perpendicular to the force.

If we now tilt the surface on one of its long edges, *b*, say for two inches, or one in six, it would no longer follow the direction of the force, but slant sideways towards this edge. Following the law of the composition of forces, one-sixth of the force, or two pounds, will now drive the surface sideways, and there being nothing but trifling skin friction to oppose it, it will obey the impulse. But if we apply a force of two pounds to the edge to balance this thrust, equilibrium will once more occur and the surface will move in the path of the force. Experimentally, far less than two pounds is required for this rest, as a considerable incline is reached before the sideways thrust is developed, the confused air currents under the surface obscuring the movement.

Note that this abutting force is of the nature of pressure. It is a static feature devoid of motion. It is a rest for the tilted surface to lean against.

It cannot be denied that we now have a case of equilibrium once more. With the two-pound rest a perfect balance results and the surface moves in the path of the force. All the force is disturbing air, while the surface moves with uniform velocity. *At that speed* it is unable to offer the least resistance to any further force which may be opposed to it. At this point the answer to a single question will be decisive. If it be in the affirmative the position is secure; if in the negative, my explanation of soaring is wrong, the birds are still in the air waiting solution.

The question is this: Will the tilted surface, supplied with the rest of two pounds and moving with uniform velocity, obey the impulse of an external force, applied in its own plane, with equal facility in any direction?

It certainly is evident that the only resistance to such a force arises from skin friction in whatever way the motion is made. If there be any other from whence comes it? It cannot come from the original force, for this is fully employed. It cannot come from the two-pound rest, as this is already balanced by the sideways thrust of the reacting air. This does not vary with the

velocity in the plane of the surface. It is two pounds at all velocities; motion in the plane of the surface does not change the *value* of the condensations, but only their *character*. It makes them thinner but wider, the total of twelve pounds being constant at all velocities; so that the two-pound abutment can only vary with the inclination of the surface to the direction of the force. It is obvious that a force applied to the surface in the direction of its length, will move it either way indifferently. It can be seen at once that the two-pound rest will not resist such a force at any velocity whatever in these directions. Leaving unnoticed any oblique motion neither longitudinal nor transverse, the important point is, will a given force, say of one pound, move the surface towards *a*, with the same velocity as towards *b*?

It is possible that when the lateral motion is set up there might be developed in the air disturbances, differences which would require an increase or diminution of velocity towards *d*, to balance the twelve pounds, and that these differences would be greater or less towards *b* than *a*. But this would in no way affect the lateral motion. Acceleration or retardation would go on until equilibrium again occurred, so that it would be a balanced surface which is moved. The vital point is: Does or can the twelve pounds in any way resist the lateral motion either towards *a* or *b*? It seems evident that there is no conceivable way in which the lateral motion in either of these directions can be resisted by the twelve-pound force, under these conditions, without at once traversing the law of the conservation of energy. The only resistance to be found is the skin friction on six square feet of smooth surface under a pressure of two pounds to the foot.

If this be a fact the case is proven. There is no other feature of it which would be denied.

Note the implications of the case. The lateral motion caused by the one pound would now carry the surface to *b*, while it is going to *d*, and it would pass to *c*, at right angles to the twelve-pound force. In going thirty feet laterally it moves sixty inches *contrary* to the direction of the force of twelve pounds and sixty inches *with* that direction, so that its path is at right angles to it. The motion of sixty inches *contrary* to the force is a function of the lateral motion and does not resist the force in the remotest manner; while motion of sixty inches *with* the force, towards *d*,

is the direct result of this force. While the lateral motion is going on at the rate of thirty feet per second, twelve pounds per second of air disturbance is flowing past the edge *b*, while but three pounds is required to give the lateral thrust and furnish the two-pound rest. If this edge be rounded upwards along its seventy-two inches of length to serve as a base for the expanding air to act against, it will give the needed three pounds and still leave nine pounds to go to waste by falling to the tension of the surrounding air. With this substitution the soaring action is complete. The force is now translating the body at right angles to its own direction. It will be noted that a velocity towards *a* greater than thirty feet per second will cause the surface to move *contrary* to the direction of the force faster than *with* it. Also, if a greater inclination be supposed, the abutting force would be greater, and the above contrary motion augmented. A limit would soon be reached in this direction, however. At an incline of one to four the rest would be three pounds, at one to three, four pounds, which latter would pass the limit of soaring, as it would require a rear expansion of five pounds to effect lateral motion, a utilization of five-twelfths of the entire force, which would surpass the ability of the system.

A single further peculiarity is to be noted. Suppose the indefinite body of air belonging to this system to be in motion, either *with*, or *against*, or at any angle whatever to the direction of the force. The action of the parts of the system would remain unaffected by such motion. It is universally recognized that the translation of a system as a whole has no effect on the interaction of its parts.

Let us now suppose the motion of the body of air containing the system be towards the earth's atmosphere in a direction tangential to its surface, at the rate of one hundred miles per hour, until the air of the system and the atmosphere became identical, we would have a bird soaring in wind of that velocity, and this wind, or any other wind, or a dead calm, or wind vertically downwards, or upwards, or at any other angle, are identical states of air so far as the soaring system is concerned.

In the earth's atmosphere, surface and air will remain the same, while the force will be that of gravity. The surface *now* has weight. It is a body plus a force, and the entire matter is the same that we have been considering. The surface is a soaring

bird. It is an inert body translated at right angles to the gravitating force, or horizontally, and solely by the action of that force. It has constant motion in the direction of gravity but does not lose its energy of position by getting nearer the earth. It resembles *in this respect* a clock moved by a weight, and placed on the platform of an elevator which slowly ascends. While the clock weight is a falling body having motion in the direction of gravity, it still does not lose its energy of position by getting nearer the earth, because of another motion in which it is elevated.

The surface, under the action of this force as above conditioned, is a splendid atmospheric highway maker. It lays down an endless cushion of air on which it travels with incredible speed. It is paralleled by nothing in nature. It is gravity in the rôle of a continuous motive power. It obeys implicitly the laws of mechanics in every particular, and gives man complete dominion of the air.

When the attention is directed to soaring in the earth's atmosphere, as exhibited by the birds, two delusions must be industriously guarded against. One is that wind is concerned in the phenomenon. The other is that the horizontal motion of flight is the result of a single impulse acting in one direction.

When it is seen that motion is derived from gravitating force exhibited by the quiescent bird in all cases, and that its level flight is a compound result of two motions, one vertically downwards, and one slanting upwards in the plane of the wing surfaces, both simultaneously occurring, the subject assumes a more explicable form.

Then when it is seen that no weight is lifted in the upward slant, this action bearing no resemblance to a ball rolled up an inclined plane, the case will be in a fair way to be completely comprehended.

In conclusion, I may be pardoned for indicating the direction in which criticism of this paper may be fruitful.

It is easy to lose oneself in the limbo of a vicious terminology. To show that expressions in regard to the gravitating force being "a continuous motive power," and conferring on it other unusual abilities not hitherto recognized, are unwarranted, is not to weaken the case. It will merely show an improper use of words.

Statements of fact regarding the plane inclined to the force, and culminating in the possibility of equal ease of motion in

any direction under the conditions given, contain the vital elements.

As an explanation of soaring birds the facts of the transformation of gravity into air disturbance, and the results flowing therefrom as stated, are pertinent. To invalidate that explanation it must be shown:

1. That such transformation does not take place.
2. That no such results as those given are possible.

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THE STONE AX IN VERMONT.[1]

BY PROFESSOR GEO. H. PERKINS.

II.—Notched and Grooved Axes.

IN all our collections we find a few axes which are notched or grooved across the narrow sides. They are not common in any portion of Vermont, nor, if we may judge from what has been published by various writers, do they appear to be abundant anywhere in the United States.

As was noticed in the preceding article we are able to arrange our specimens in such a manner that there is a very complete series from the simplest celt, through the notched ax, to the fully grooved ax, and it seems quite probable that the notched ax was the second step in the development of the ax from the simply edged pebble. The form of the notched ax is more like that of the common celt than is that of the grooved ax. In fact some of the notched axes are nothing else than celts notched at the sides, and they are never so large and heavy as are many of the grooved axes.

Fig. 1.

A type of these axes is shown in Fig. 1, which represents a common form, about one-half the natural size.

As a rule these axes are not more than four or five inches long and two or three wide. They are usually well shaped, neither rude nor clumsy, and the surface is smooth or perhaps polished. The form of some is such as to suggest the adze, and it seems quite likely that an implement so useful in hollowing canoes and

[1] Continued from p. 1149, December number, 1885.

performing many of the labors which we know to have been undertaken, was in common use among the prehistoric tribes as it has been for a long time among modern savages, and yet I do not remember that the early writers to whom we always turn for information respecting the customs of our predecessors, say very much of the use of such a tool in their accounts of these people. It is not impossible that some of the implements which we call celts may have done duty as spades, and that some of the ruder "notched axes" may have been, not axes, but hoes. The notches or grooves are always much wider than deep, although the depth varies very greatly in different specimens, but I have never seen it as great as in the grooves of some of the larger grooved axes. The notches are usually about a third of the length below the blunt end of the ax, though in a few cases they are near the middle, as in Fig. 2. These axes group themselves naturally into two classes—those in which the width greatly exceeds the thickness and in which the surfaces are nearly or quite flat, and those in which the breadth and thickness are more nearly equal and in which the surfaces are often convex. Some specimens have one surface quite flat and the opposite convex, just as is often the case in the celts, and it is possible that these were used as skin-dressers or fleshers, and without a handle, the notches serving as convenient places for the fingers as the hand grasped the tool. The specimen shown in Fig. 1 is of dark porphyry and is polished over the whole surface, and is, as indeed are most of these implements, made with care and skill. It is four and a quarter inches long and two inches in greatest width. In Fig. 2 we have quite another form of ax, and one which is not common. It is about four inches long and two and a half inches wide. It is made of trap, and it is noticeable that most of these small axes are made of hard, compact material. I have seen no specimen of the notched ax which, like some of the celts, was sharpened at both ends, but one or two of the latter are drawn in near the middle as if the maker had thought of notching them that a handle might be more firmly attached, and these are almost notched axes, although the notch is so very slight that I have not thought best to include these specimens in the present article.

FIG. 2.

With very few exceptions the grooved axes found in Vermont are larger than those we have called notched axes. They are not at all abundant in any part of the State, and in the northern counties they are very rare. It is quite remarkable that in some localities where celts and other implements are especially common, grooved axes have been very seldom found, if at all. As compared with the Southern or Western grooved axes, our Vermont specimens present differences which are sufficiently noticeable when one looks over series of each, but which can not readily be made apparent in words. Our axes are, in size, intermediate, none of them being so small as the little " toy " axes found in other localities, nor are any so large as many that have been found. Neither do we find axes grooved only on three sides, but in all our specimens the groove extends entirely around the ax. In the collection of the University of Vermont there is one specimen, which is doubtfully of Vermont origin, in which the groove is found only on three sides, but in all the rest the groove is completed around the specimen. This is somewhat remarkable, because, according to Dr. Abbott (Primitive Industry, p. 8): " Possibly two-thirds of the stone axes found in New Jersey have the groove extending along the sides and across one margin;" and the same author speaks of " one-half probably of the axes found in Connecticut and northward having the groove entirely encircling the stone," and by inference the other half were not so. Our axes usually have the groove a little above the middle and parallel with the edge. It is never very near the blunt end, as in some of the Western specimens, nor is it ever bordered by a raised lip. Our average specimens are from five to seven inches long and about two-thirds as wide, and weigh two or three pounds, but occasionally they are larger, as is the specimen shown in Fig. 5, which is one of the largest axes I have seen from this region. Some of our grooved axes were evidently made from cobble stones, and in some of these the upper end is left very much in its original condition with its water-worn surface unwrought. The same form seems to have been copied in specimens the entire surface of which is wrought, for although these may show everywhere tool-marks, the form of the head is precisely that of those in which it is the natural water-worn pebble. In general form the Vermont axes are noticeably wider, shorter and thinner than the typical Western specimens, and therefore less clumsy and heavy, even when

of the same length. The long, slender axes found in some of the Western localities do not occur in the Champlain valley.

Our grooved axes are not often very rude but, though seldom polished, the surface is generally well picked and smoothed. The edge is, naturally, always polished, but the groove is not in any specimen so completely smoothed that the pits and striæ made by the instruments used in excavating it are obliterated, and in most cases there is little attempt at polishing it. Even when the rest of the surface is smoothed, the groove is not. This is unlike what is common among stone axes from other places, for in these we very often find the groove finely polished.

In Fig. 3 we have represented a specimen of singular form, and in some respects unique.

As the figure shows, the notches are very deep, though the groove is quite shallow, and the form of the head above the groove is unusual. The material of which this ax is made, instead of being of trap or quartzite, or some such hard, compact stone, is quite peculiar in that it is of a red sandrock common along Lake Champlain, and which is not a very suitable material for an ax. As shown in the figure this specimen appears more rude and ill-finished than it was originally, for, either from the effects of weathering or hard usage, the smooth surface which evidently existed at first, has been flaked off in many places, giving a rude appearance.

FIG. 3.

This is one of the larger of our axes, the length being eight inches, width across the head four and a half inches, while the general width below the groove is four inches. The special peculiarity of this ax is found in the obliquity of the edge, which is not very well shown in the figure. That portion of the ax below the groove is not worked to the same plane as that above, but is as if twisted spirally so that a line drawn parallel to the edge would cross at a large angle a similar line drawn across the head or parallel with the groove. Nor is this an isolated example. In a fine large ax in our collection, from Springfield, Mass., the same obliquity in

the lower part is seen, and in several celts I have seen the same form. So marked is this twist that it would seem impossible to strike a fair blow with such an ax if it was attached to a long handle, and this difficulty raises the question whether some of these large grooved axes may not have been hand axes, not many of them, perhaps, but a few. The head of the Springfield ax is rounded carefully, and indeed the whole ax is very well made, and when held in the hand with the ends of the fingers in the groove, it seems most admirably adapted for use in this way. I am aware that the groove in itself suggests a handle of some

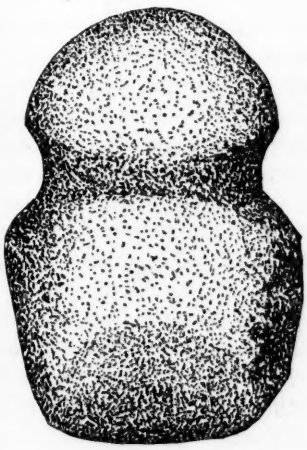

FIG. 4.

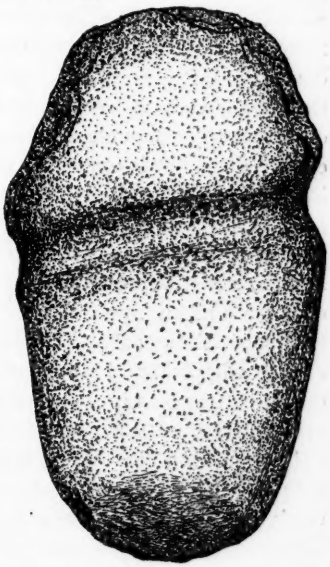

FIG. 5.

sort, but, as has been noticed, in the case of these oblique axes at least, the hand and arm of the user would surely make a much better handle than any other. The form cannot be regarded as accidental, I think; the specimens are too carefully and thoroughly made to allow place for such a supposition.

The general character of our Vermont grooved axes is very well shown by Figs. 4 and 5, which represent the two classes most often found. Both of them are comparatively quite flat or thin, and our grooved axes never approach a cylindrical form, but are always narrowly elliptical in cross-section. Scarcely any

two specimens are alike, but most of them resemble more or less closely one or the other of the forms here figured. The specimen shown (very much reduced in size) in Fig. 4 is a very well made and finished ax, worked out of a syenite cobble-stone, and the upper end apparently still retains the general form of the pebble. It is of average size, being five inches long and three and a half inches wide just below the groove. This specimen illustrates the short and wide form, while the less common and longer form is seen in Fig. 5. This ax is one of the largest specimens, and most, if not all, of this form are large. Some of them are less rude than that figured, which shows the effects of hard usage, though it probably was very well finished at first. It is made of a dark gray grit or hard sandrock, much like that used for making the harder varieties of grindstones. The flat surfaces are rubbed quite smooth, although somewhat pitted. The groove is only moderately deep, but is unusually wide, and is smooth as if worn by long usage, and as the figure shows, it runs obliquely. Both sides are flat, one somewhat more so than the other, and the edge is formed by beveling the surface, mainly from one side. This ax, and the same is true of all of this form, was evidently worked out of a mass taken from a ledge. Not only does the smoothness of the groove show that this implement has been much used, but the edge is chipped and broken somewhat, and the head very considerably battered as if it had done hard duty as a maul. It has been thought by some that these large axes were, some of them at least, used to break holes in the ice in winter for fishing or to get water, and this specimen may have served for some such work. Very few axes so large as this have been found in this State. The figure is somewhat more than one-third natural size. The length is a little over nine inches, and the width above the groove nearly five and a half inches, while just below the groove it is five inches. The specimen weighs four pounds, which is much less than that of some of the Southern specimens. The inequality of the two flat sides, which is sufficient to be quite noticeable in this specimen, is still more marked in some others, and, as in the celts and other forms of the ax, this flattest side is always smoother, sometimes very much so, than the opposite side, a fact for which it does not seem easy to account. In a skin-dresser or hand ax it is quite natural that the side which, from accident or intention, was most nearly flat should be held down upon the

skin or whatever the surface that was being worked, and thus become smooth and flat even if not made so at first, but how anything of this sort could take place in a large, hafted ax we are unable to guess, unless it was used as an adze, and this is possible. The oblique direction of the groove seen in this specimen is worthy of notice, since it does not appear to be common in New England specimens. Dr. Abbott (Primitive Industry, p. 8) says that in the valley of the Susquehanna river in Pennsylvania the majority of grooved axes have the groove oblique with reference to the edge, but that this feature is rarely met with in New Jersey and "probably does not occur in New England. There is no example in the large series of New England axes in the museum at Cambridge." Several of our Vermont axes, all I believe from the northern part of the State, have oblique grooves.

I do not think that archæologists have given the grooved ax sufficient credit for utility as a cutting implement. They seem for the most part to be of the opinion that at best these axes could be used only to cut into the bark and bruise the wood so that a fire kindled about a tree so prepared should have greater effect. This may very probably have been a common, perhaps the common, method, and yet the accounts given us by the early explorers of America seem to me to prove that trees were cut, and cut so that they came down, with stone axes. We must always be on our guard against rendering judgment as to the usefulness of a stone implement if we have no other basis for our decision than the results accomplished by it in our unskilled hands. We all know that stone implements that would be wholly useless in civilized hands are yet of very great efficiency in the hands of savages who have learned how to use them. Many of our stone axes do indeed seem quite unfitted for use as cutting tools, and they may be so, but all are not; some are made from very hard stone and have a smooth, regular edge which, although it may not be comparable to that of a modern steel ax, is yet able to cut soft green wood if not that which is harder. To cite in proof of this only a single writer, let me call attention to one or two statements made by Champlain. The earliest edition of the writings of this explorer, which is now at hand, was published in Paris, 1830, a reprint of course of earlier volumes, but sufficient for our purpose. In his account of a journey which he took with a party of Algonkins in 1609, Champlain speaks several times of

the stone axes as used to fell trees, and some of these were "gros arbres," and the account shows that the cutting must have been done with somewhat of expedition. His party had iron axes as well as stone, but our author does not compare the two, but calls them all "meschantes." In describing the customary method of camping when enemies were supposed to be near, he tells us that as soon as the Indians had chosen the place for a camp, they immediately began to cut down trees to make a barricade, and he says that they know so well how to do this that in less than two hours they have so strong a defence that five hundred of their enemies would not be able to break into it without great difficulty and loss of life. Then in another passage he speaks of the Iroquois cutting down trees for a similar purpose. Nowhere does he speak of fire as an aid in the process. Indeed in the first case where he tells us of so strong a barricade, he says that they make no fire lest the smoke reveal their presence to their enemies.

From these and similar accounts it seems quite probable, to say the least, that stone axes were used as axes for cutting timber, and with not altogether unsatisfactory results.

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GROSSE'S CLASSIFICATION AND STRUCTURE OF THE BIRD-LICE OR MALLOPHAGA.[1]

ABSTRACT BY PROFESSOR G. MACLOSKIE.

THE Mallophaga, or bird-lice, are wingless insects with incomplete metamorphosis, mandibulate mouth-parts, two or three-segmented thorax, eight to ten abdominal somites. They live on mammals and birds, feeding on their scales, hairs and feathers. The genera which are found on mammals never occur on birds, and *vice versa*. Redi first observed (1688) that there are some lice with haustellate and others with mandibulate mouth-parts. Nitsch (1842) carefully examined them, and Von Giebel (1874) improved on his work.

Nitsch divides them into two chief groups, Philopteridæ and Liotheidæ; the Philopteridæ have filamentous antennæ and no palps; the Liotheidæ have clavate four-jointed antennæ and palps. The Philopteridæ comprise two families: (1) Trichodectes, the

[1] Beiträge zur Kenntniss der Mallophaga, von Dr. Franz Grosse in Strassburg. Zeitschrift für wissenschaftliche Zoologie, Bd. XLII, pp. 530–558, mit Taf. XVIII (1885).

only genus, characterized by three-jointed antennæ and one-clawed feet; (2) Philopteridæ, *strictè*, with five-jointed antennæ and two-clawed feet.

The Liotheidæ have likewise two families: (1) Gyropus, the only genus, having one-clawed feet; and (2) Liotheidæ, *strictè*, with two-clawed feet.

Trichodectes and Gyropus occur only on mammals, the other genera only on birds, and are classified according to the presence or absence of appendages on the head (trabeculæ) and their motility, to the sexual differentiation of antennæ, their attitude, the form of the head, the consistency of the thoracal somites and the form of the last abdominal somites.

PHILOPTERIDÆ, *strictè*.

1. Trabeculæ motile, antennæ nearly alike in both sexes ..... *Docophorus.*
2. Trabeculæ not motile.
   - *a.* Antennæ filiform, no sexual differentiation.
     - (*a*) Hind-head rounded off, terminal somite of male rounded off. . *Nirmus.*
     - (*b*) Hind-head abruptly angled, abdominal somites fused in the middle *Goniocotes.*
   - *b.* Antennæ of male forcipate by a process from the third segment.
     - (*a*) Hind-head angled, terminal somite of female tubercle-like, of male rounded off..... *Goniodes.*
     - (*b*) Hind-head rounded off, terminal somite of male notched ... *Lipeurus.*

LIOTHEIDÆ, *strictè*.

1. Mesothorax wanting, antennæ generally concealed.
   - *a.* Head very broad, no orbital sinus..... *Eureum.*
   - *b.* Head elongated, with lateral angles directed backwards.
     - (*a*) With sharply marked-off clypeus and shallow orbital sinus *Læmobothrium.*
     - (*b*) With only wavy head-margins, and long lateral lobes on the labrum *Physostomum.*
2. Mesothorax present.
   - *a.* Mesothorax large, sharply marked-off, head three-sided, antennæ concealed *Trinotum.*
   - *b.* Mesothorax small, only indicated.
     - (*a*) Orbital bay deep, antennæ mostly elongated and visible. *Colpocephalum.*
     - (*b*) Orbital bay very shallow or obsolete, antennæ concealed.... *Menopon.*

Grosse's researches have been largely on a Liotheid found on a pelican from Chili, closely related to Menopon and forming the type of a new genus and species, *Tetrophthalmus chilensis.* The male is 4–4½ mm long, the female slightly less. He also contributes important emendations of our knowledge of the other species.

Head.—In Tetrophthalmus the head is somewhat constricted, is broader than long, slightly convex above, concave below, and

somewhat uniform, the occipital angles being rounded off. The hinder limit of the clypeus shows on each side a notch, about a third from the front of the head; two dark spots are seen on each side of the head, the larger one near the notch, the other behind it and outwards. The antennæ lie concealed in a lateral cavity of the under side of the head (as in Læmobothrium, Fig. 1 *at*). Two eyes, whose pigment is seen from above, lie on each side below and behind the antennal cavity. Hairs are distributed over the head, along the borders and on its ventral and dorsal surfaces. On the under side of the head is the funnel-shaped mouth-opening, surrounded by the mandibulate mouth-parts. Grosse describes the mouth-parts of Mallophaga in detail, as previous writers err greatly regarding them.

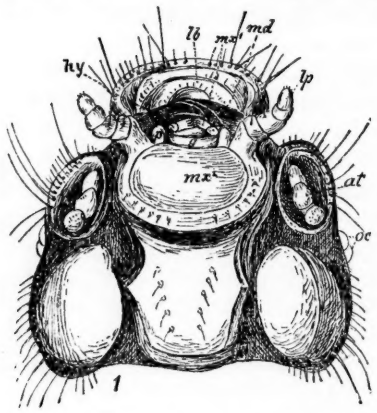

FIG. 1.[1]—Ventral view of head of Læmobothrium from *Gypogeranus serpentarius*. × 30.

Labrum (oberlippe).—This is not, as in other insects, inserted on the anterior border of the head, but in all Mallophaga it is

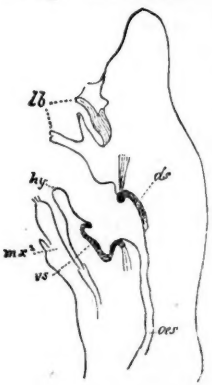

Fig. 2.

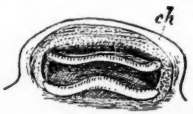

Fig. 3.

FIG. 2.—Median section through head of *Goniodes dissimilis*. × 60. FIG. 3.—Labrum of *Goniodes dissimilis*. × 60.

[1] *Explanation of reference letters in the figures.*—*at*, antennæ; *ch*, chitinous bar; *ds*, *vs*, dorsal and ventral parts of œsophageal sclerites; *g*, glossa (ligula); *gs*, glassy body; *h*, hypodermis; *hy*, hypopharynx; *is*, *os*, inner and outer side of maxilla; *l*, lens-shaped chitinous thickening; *lb*, labrum (upper lip); *l.md*, *r.md*, left and right mandible; *lp*, labial palp; *m*, muscle; *md*, mandible; *mt*, mentum; mx^1, 1st maxilla; mx^2, 2d maxilla (labium or under lip); *oc*, eyes; *oes*, œsophagus; *on*, optic nerve; *p*, paraglossa; *r*, retinal cells.

on the under side of the head. In all Liotheidæ it is similarly formed (Fig. 1 *lb*), being a thin transverse arched swelling, with chitinous margins bearing small bristles. The labrum of the Philopteridæ has a broad disk-like basis fixed on the under side of the head, and is divided by some transverse furrows (Figs. 2, 3, 5 *lb*). There is a broad furrow, separated from the mouth by a plate of chitin, and farther forward a deep narrow furrow, next the anterior boundary of the labrum. In the living animal the labrum is constantly moving; and in Philopteridæ it can adhere to glass like a suctorial disk. The labrum can thus hold on to hairs or feathers.

Mandibles.—As a type we take the mandibles of Tetrophthalmus (Fig. 4). They have each two strong, long teeth, somewhat different in their structure.

The under tooth of the left mandible has a protuberance with curved point and an arched surface; its upper tooth has two points. The right mandible has two stout teeth which fit the left mandible on closing. This serves for cutting particles held between the labrum and the first maxillæ. The large pointed teeth serve for removing dermal scales. The mandibles of the Philopteridæ are long, triangular and two-toothed, the teeth short and thick (especially in genus Docophorus).

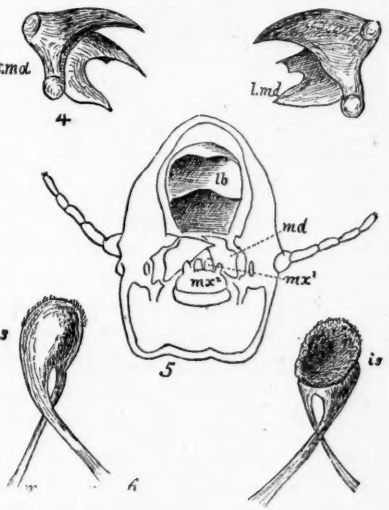

FIG. 4.—Right and left mandibles of Tetrophthalmus. × 60. FIG. 5.—Head of *Lipeurus heterographus*, seen from below. × 60. FIG. 6.—First maxillæ of Tetrophthalmus. × 75.

First maxillæ.—These are conical, and have a basal and a terminal segment or blade, distinguishable in young specimens. The inner side of the blade has hooklets (not in Docophorus) (Figs. 5, 6). The maxillæ seem to take no part in comminuting the food beyond aiding in its prehension. With all care

Grosse has never been able to find the palps of the first maxillæ which Nitsch ascribes to Liotheidæ. Nitsch figures them in *Trinotum conspurcatum*, but this can scarcely be correct, for he places the four-jointed papillæ on the blade near its anterior border. In Tetrophthalmus the palps belong not to the first but to the second maxillæ. The same is true of *Menopon pallidum*, *Colpocephalum zebra*, a Læmobothrium from *Gypogeranus serpentarius*, and a Trinotum from the swift, and probably is the case with all the genera and species.

Second maxillæ (unterlippe).—These are flat, fused, bounding the mouth posteriorly. They consist, in Liotheidæ, of two parts which are united by a transverse fold (Fig. 8). The basal part (mentum, *mt*) represents the coalescing stipites and squamæ of normal first maxillæ, and bears the four-jointed labial palps. The upper part is the ligula or glossa (*g*) corresponding to the inner blade [lacinia]. Laterally on the ligula are the paraglossæ (*p*), corresponding to the outer blade [galea]. A chitinous band limits the glossa where it bears the paraglossa, as if the parts of both had coalesced.

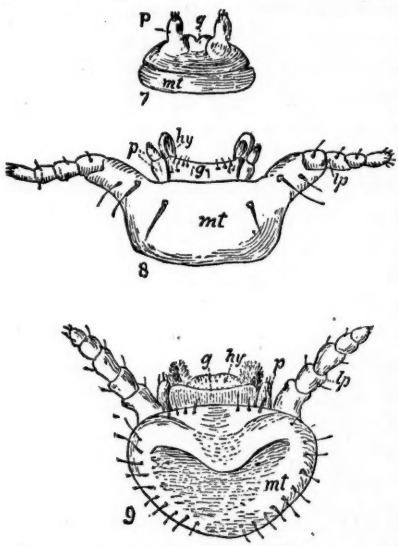

FIG. 7.—Second maxillæ of Nirmus. × 60. FIG. 8.—Second maxillæ of *Tetrophthalmus chilensis*. × 60. FIG. 9.—Second maxillæ of Læmobothrium. × 60.

Rudow seems to have mistaken the antennæ for the labial palps. Melnikow overlooked the labium, and erroneously compared the products of the œsophageal intima with the proboscis of Pediculina, in consequence of this false comparison referring the Mallophaga to Rhynchota.

The labium of the Philopteridæ has no palps (Fig. 7). It is usually triangular, with rounded angles, and is sometimes very small, as in the genus Lipeurus, the mentum being smaller than

the ligule. The ligule is emarginated in Docophorus and Lipeurus. The paraglossæ of Philopteridæ, as in the Liotheidæ, are like tactile-organs, remarkably long in species of Goniodes.

In all Liotheidæ the intima of the ventral end of the oral cavity forms a fold-like duplicature as in Philopteridæ (hypopharynx, Fig. 2 *hy*). In Læmobothrium and Tetrophthalmus this extends forward over the labium, and its lateral borders are strongly bent upwards (Figs. 1, 8. *hy*).

For the study of the head Grosse made transverse and sagittal sections of specimens fresh from molting and hardened in chromic or picric acid. From absolute alcohol they were placed in chloroform and after two hours embedded in paraffine, being kept for a time in melted paraffine under the air-pump. The sections were attached to the slide by means of albumen or oil of cloves, stained by alcoholic carmine-solution, treated with acidulated alcohol so as to show the nuclei, and then enclosed in Canada balsam.

Thorax.—In the genera Trinotum, Colpocephalum and Tetrophthalmus the three thoracic somites are present, especially manifest in the young. The prothorax of Tetrophthalmus has above a rounded swelling, and ends forwards in a bristly point on each side. Within the prothorax, but visible through the transparent dorsum, is a cross-band of chitin, as in Menopon, for the attachment of muscles. The mesothorax is much narrower than the other thoracic somites. The metathorax is of trapezoidal form, and much broader and shorter than the prothorax. The borders of these somites are strongly chitinized. There are no wings or rudiments of wings. The foremost of the three pairs of limbs are the shortest, and they act as foot-jaws, drawing fragments of food to the mouth. In the male Tetrophthalmus they are large and also serve for holding the female. The tibia of all the limbs of the male have their inferior end extending into a knob with sharp processes like a "morning star." There are only two tarsal joints, the distal one being the longer and bearing two incurved claws, inclosing between them a soft lobe [pulvillus]. The bristles on the tibia and the "morning-star" processes of the male serve for holding the female, which indeed often clambers among the feathers of the host.

Abdomen.—The female of Tetrophthalmus has ten abdominal somites, the terminal one soft and rounded. The male has nine,

as the last is invaginated so as to serve as a sheath for the penis; the hind end of the male is pointed and more chitinized, and more darkly colored than in the female.

Digestive track.—Two types of crop are found in the Mallophaga. In Philopterida the crop is a lateral diverticulum of the œsophagus; in Liotheidæ it is a club-shaped symmetrical enlargement of the œsophagus. Kramer divides the intestine of Lipeurus into an oral-cavity, an œsophagus, crop, chylus-stomach and hind-intestine. The œsophagus reaches back to the abdomen, and has a homogeneous chitinous intima. The intima of the crop has spines, and its cells appear to secrete a fluid. The chylus-stomach extends to the entrance of the malpighian tubules. Grosse finds in the œsophagus of Tetrophthalmus, behind the hypopharynx, a chitin-bar produced by thickening of the intima, consisting of a groove-like mid-piece, and running forward and backward into two diverging branches. The hind branches have muscles from the occipital border of the cranium. These chitinous bars are not haustellate, but support the oral intima, and in their groove are sent along comminuted fragments of feathers, retained by the retrorse spines and denticulations of the dorsal part of the intima.

Goniodes has two squamous œsophageal pieces, a dorsal and a ventral (Fig. 2, *ds*, *vs*). The ventral piece has posterior processes joined by muscles with the occipital border. The dorsal piece sends forward a muscular bundle, which bifurcates and its divisions are inserted on the anterior cranial border. Two ducts (probably salivary) run forwards through these scale-like pieces, uniting into one. The chylus-stomach is cordate at its beginning, and has no chitinous intima. The hind-intestine has six longitudinal grooves, and rectal glands with richly branching tracheæ and a chitinous intima.

The mode of nutrition of Mallophaga is not fully ascertained. Nitsch stated that they eat the epidermal products of birds and mammals, and sometimes blood. Grosse finds that blood is rarely taken, and only in cases where the bearers (birds) are so injured or diseased as to have blood among their plumage; and Leuckart gives the same result as to *Trichodectes canis* of the dog. In Læmobothrium, Grosse found the intestine filled with the limbs of its own kind, as if it ate the product of its own molting.

Malpighian vessels.—These are four, not branched; have a lumen and ganglion-cells (not separated from the lumen by any membrane).

Salivary glands.—There are two pairs; and exceptionally the Philopteridæ have one-celled glands as on the crop. Grosse found one of these cells undergoing division. The salivary organs include salivary glands and salivary reservoirs. The glands usually adjoin the crop or stomach, and have a cell-layer with nuclei, covered externally and internally by a fine homogeneous epithelium. Before the entrance of thin ducts into the œsophagus, a gland and a salivary vessel unite into a common duct.

Sexual organs.—The male sexual organs are of the usual type of insects, paired testes, spermatic ducts, a seminal vesicle, ejaculatory duct and penis. Nerves supply the seminal vesicle and ejaculatory duct; and in Tetrophthalmus the terminal somite of the abdomen is withdrawn so as to be concealed, serving as a sheath for the penis. The female organs consist of paired ovaries (three pairs of ovarian tubes in Liotheidæ, five pairs in Philopteridæ), two oviducts uniting into one and a seminal receptacle. The egg-case has a lid which springs open at the exit of the young insect.

Respiratory apparatus.—There are seven pairs of stigmas, one in the prothorax and six abdominal. Each stigma has internally a crown of fine hairs to protect from impurities. A pair of strong longitudinal tracheæ send branches to the stigmata and are united to each other by a strong cross branch in the abdomen, and smaller ones in the head and thorax.

Dorsal vessel.—Grosse could not succeed in making a preparation of this, but in the recently molted living animal it can be seen pulsating through the back.

Nervous system.—This consists (in Philopteridæ) of two cephalic ganglia and three thoracic ganglia. The precœsophageal ganglion is much larger than the subœsophageal, and they are united by strong commisures. The last thoracal ganglion is large, and sends back nerves to supply the abdomen.

Antennæ.—In Liotheidæ these are four-segmented, club-shaped or knobbed, the terminal segment spherical, lying in a hollow of the sub-terminal one (Fig. 1 *at*). In a cross-section of the terminal segment of Læmobothrium are seen round nucleated cells, apparently ganglionic enlargement of nerves. The Liotheidæ

have the antennæ alike in both sexes, but in Philopteridæ the third segment of the antennæ of the male has a lateral process, sometimes so large as to make the antenna resemble a lobster's claw. Nitsch states that it is for holding the female.

Eyes.—These lie on the margin of the under surface of the head behind the antennæ. Authors have hitherto ascribed a single pair of eyes to all Mallophaga. But in all Philopterid genera examined (Goniodes, Docophorus, Lipeurus, Nirmus) the author found a single pair, and in all Liotheid genera (Tetrophthalmus, Læmobothrium, Menopon, Trinotum and Colpocephalum) he found two pairs of stemmata. If this character holds good for the remaining genera it will still further separate the two chief divisions of the Mallophaga.

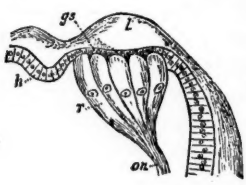

FIG. 10.—Eye of Læmobothrium seen on cross-section of head. × 190.

The eyes of Mallophaga are simple, provided with a lens-shaped thickening of the cuticle. In young specimens the eye has no pigment, but in older specimens it has pigmented retinal cells. The eye of Læmobothrium, examined by means of sections, has, under the chitin-thickening (Fig. 10 *l*), twenty-four pigmented retinal-cells (*r*), clavate and nucleated with nucleoli, merging gradually into the pigmented optic nerve (*on*). Each eye is directly innervated from the præœsophageal ganglion. The hypodermal cells are interposed between the lens and the retinal-cells, as cubic cells in old specimens, but as a hyaline body consisting of cylindrical cells in young or recently molted specimens. There are no rhabdites in the eyes. The eyes of Mallophaga resembles those of *Phryganea grandis*, as described by Grenacher.

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TRACK OF A CYCLONE WHICH PASSED OVER WESTERN INDIANA MORE THAN THREE HUNDRED YEARS AGO.

BY JNO. T. CAMPBELL.

LAST April (1885) I was surveying in the west-central part of Parke county, Indiana. On the south side of Section 16, Township 15 north, of Range 8 west, I noticed that the tree graves were very numerous, there being one to every square rod

of ground. I noticed that they all indicated that the storm which caused them was going to the north-east. When a tree is blown down the roots hold two to five cubic yards of earth in their grasp, which makes a corresponding pit where the tree stood; after the fallen tree has entirely rotted, the earth held by the roots leaves a mound resembling an old grave, and have been very commonly called by people here, "Indian graves." The mound is always on the side of the pit toward which the tree fell.

This storm track was about one thousand feet wide. I at that time followed it nearly one mile. Just before I ceased tracing it I found the stump of a white oak, cut down during the year 1884, standing on top of one of the tree graves or mounds. I counted the rings of growth and found it to have been two hundred and ninety-seven (297) years old. That settled the fact that the storm had passed over the ground at least three hundred and ten years before; for the acorn could not sprout on the mound until the tree had first been blown down; and second, it could not sprout till the fallen tree had also rotted away, and left the mound sufficiently flattened for moisture to rise to its top surface.

On the 18th of May following I was surveying in Section 29 and 30, Township 15 north, of Range 8 west (which surveyors in the West will understand is about three miles to the south-west of the first place mentioned). Here I also found the tree graves as thick as the grown trees now are, and they also indicated that the storm which blew down the trees which made these tree graves, was going to the north-east. A moment's reflection also showed me that this was on the same line or track of the one first observed.

After I returned home I placed a string on my county map so as to cover these two locations, and noted carefully what points across the county the string touched. I noticed that by extending the string south-westward it passed about one-half to three-quarters of a mile to the right of Clinton, in the south end of Vermilion county, which adjoins this county on the west, the Wabash river lying between them. Clinton stands on the west bank of this river. I at once remembered that when a boy in my early "teens" I had lived with a Dr. Kile, two and a half miles south-west of Clinton, and in my frequent trips to town I often noticed the tree graves, which in my simplicity then I supposed to be in fact real "Injun graves." They were very numerous,

and I supposed there had been a great battle between two hostile tribes of Indians, and that these mounds were the graves of the unknown braves. There were not the very faintest trace of fallen trees in connection with these graves, so thoroughly had they rotted away. I found by applying the string to the map that these graves were in a line with those I had recently found in this (Parke) county.

On the 8th of July following (1885) I was making a survey in the north-east part of the county, in Section 29, Township 17 north, of Range 6 west. While at the dinner table I told one of the land proprietors that I had recently got upon the track of an ancient storm which, if it had kept on the course I had observed should pass over the ground we were then eating our dinner on. I asked him if he had ever noticed any trace of it. He said, "Yes. When I was a boy and young man the 'Indian graves' out in that field [pointing south-eastward] were so thick that I could jump from one to another all over that part of the farm." I asked what course the storm was going, and explained how he would know by the position of the mound in relation to the pit. He said north-east, and told me what farms it crossed, and about where it crossed the county boundary into Montgomery county, which was close by. This was over fifteen miles from where I had first discovered the track, and I had not missed its location where I am now speaking about more than seven hundred feet.

The next day I was going to another part of the county, and had to travel south-westward several miles, and crossed the storm track. I saw a man in the edge of a field harvesting. I told him what I had discovered, and asked him if he had ever noticed it. He answered, "Yes. When I was a boy the Indian ('Injun') graves just below that sugar camp [grove of sugar maples] were as thick as stumps in a new clearing. We boys used to count them to see how many Indians had been killed in battle." It was the general belief of the children of the early settlers that these were Indian graves, and that where they were numerous, as in a storm track, that there had been a battle between tribes. The place he pointed out was in the track I was looking after.

I may here remark that after the land is cleared and cultivated, the plow in a very few years destroys all trace of these graves. Hence my inquiries of persons who had known the country from the days when it was an unbroken forest.

This storm would pass, in going north-east, about two miles to the left of the city of Crawfordsville, Indiana, the county-seat of Montgomery county. Though it might change its course farther on.

At, or very near the spot where I counted the age of the oak which had grown on one of these tree graves, there still stands on another mound a white oak considerably larger than the one I counted, though it may not be an older one. I have delayed writing this account over six months, expecting a miller to cut this larger tree so I could count its age, but it has been neglected so long that I have decided to write from what information I now have.

These tree graves are, in the wild forest, as well preserved and as distinct in outline, although more than three hundred years old, as many that have been made by trees that have fallen within my own recollection. If the same conditions that have so well preserved them for that time should continue in the long future, I see no reason why these mounds might not be preserved five thousand, yea, ten thousand years.

What does the reader guess has so well preserved these little mounds for so long a time? It is nothing more nor less than a thin coating of forest leaves. The leaves act as shingles in shedding the rains, so that they are not washed or worn down by the falling rain or melting snow. The frost does not penetrate through a good coating of leaves, and therefore they are not expanded and spread out by freezing and thawing. I can see a great difference between the mounds in the wild forest and those on land that has been set to grass and pastured a few years. The tramping of stock and the frequent expansions from freezing, which the grass does not prevent, flattens them perceptibly. The grass, however, does preserve them against rain-washings. When a belt of forest is blown down there are no trees to produce leaf shingling till a new set are produced; but these come in great abundance in ten years. It requires about fifteen to twenty years to rot a sound white oak. The time will depend on the lay of the log, whether it falls across another log and lies above ground, or lies on or is partly bedded in the ground.

I now offer a conundrum in connnection with this subject for whomsoever may feel an interest in it to solve. I have partly solved it myself, but not entirely to my satisfaction. I have, after

much observation, noticed that not more than one-tenth of the surface of the present forests show any trace whatever of any storms, recent or ancient. If storms have been as frequent and as destructive in the past as in my day (of fifty-three years), and the elements of preservation of the mounds have existed in the past as now, why do I find so few storm tracks as I have mentioned? It would seem that in three hundred years, if storms had always been as frequent as in our time, and in the same haphazard manner, there would not be a square rod of ground that would not show some trace of a storm.

I give my explanation for what it may be worth, but is short of all the facts of explanation. I am able to say of the storm I have described, with as much confidence as if I had been present and seen it: First, that it occurred when the trees were in full leaf; second, that there had been a protracted rain; third, that many of the trees blown down were white oak; fourth, that one was a large poplar; and fifth, that very few, if any at all were black walnut. And for the following reasons: The *great* storms do not now occur before the leaves are on. Without the resistance against the wind offered by the leaves, it is very hard for any storm to uproot a green tree. If the ground is dry and hard, or frozen, the trees will break off at or above ground. And in such case they would leave no tree graves, which may account for the few tracks I find. An oak leaves a deep, round pit and a plump, round mound. A poplar leaves a broad, shallow pit and a long, slender mound. The black walnut is very rarely "blown up by the root." I have seen this country from an unbroken forest to the present time, when four-fifths of the land is cleared for the plow or pasture, and I don't remember that I ever saw a black walnut blown up by the root. I have seen many broken off. They have a very firm root, and are, when mature, a little doughty at the stump, but very sound from ten feet above ground upward.

I have seen and still know of other large trees which stand on the graves of former fallen trees. Some of these trees are very large, but the size of a tree is such an uncertain indication of its age, that I can't say with much certainty how long the mounds, on which they stand, have existed. One thing is certain, the mounds are older than the trees. At the Fair ground, a mile west of where I am writing (Rockville, Indiana) are several such

cases; and on the grounds of the now growing famous resort in our county, "Turkey run," or as it is called by people away from here, "Bloomingdale glens," are several such cases.

In a future article I shall show how the forest leaves have preserved the sides of hills and thus allowed the small streams to cut out the bottoms of the hollows deep, steep and sharp, which are rapidly changing since the country has been cleared and farmed. Also how they have preserved the ancient beds of streams along the terrace bottoms of the Wabash river and its principal tributaries till they are as sharply defined after the lapse of no one can venture to guess how many thousands of years, as they were when the last great final flood that cut out the beds swept over these plains.

I have said the storm here described was a cyclone. This I infer from the way the trees had fallen. In some parts of the track the trees were thrown in every direction, and the course of the storm could only be determined by the general course of the track, and not by the fall of individual trees.

The course of this storm is N. 44° 30′ E. in this county. In all my recollection of storms I never saw but one (in 1883) which bore so much to the north, and that one was the most threatening and awful in its appearance I ever saw, and did in localities much damage. Its course was about N. 37° E., or about 7° 30′ more north than the ancient one. The great majority of the storms I have seen, and of those which have left plain tracks, are from a few degrees north to a few degrees south of west.

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ON THE MOUNTING OF FOSSILS.

BY FRANKLIN C. HILL.

THE five expeditions which have gone to the far West from Princeton have brought in many valuable fossils—invaluable is perhaps the better word—chiefly remains of vertebrates.

For the double purpose of utilizing and of preserving these treasures they have been mounted in a manner new in this country, and it is believed not common abroad, though somewhat practiced there.

The leading idea of the system is that each piece shall be set up in its natural position.

Our museum now contains nearly 400 such specimens, which

have attracted much attention and admiration from visitors, both scientific and lay, and I have been often urged to publish some account of my methods and results.

Although many fossil bones are whole and clean when found, many more of them are broken and more or less clogged with matrix. The freeing of this last and the mending of the broken are troublesome and delicate tasks. Mallet and chisel come into play, their sizes depending on the nature of the case. For the heavier work ordinary stone-cutter's tools can be used, yet it is commonly better to make haste slowly and use needles, and no needle is more useful than a No. 1 sharp. By wrapping the eye end of the needle with a narrow strip of paper it can be made to fit in the clamp of a patent sewing haft, and a chisel made, which with a dogwood stick of from one to one and a-half inches diameter and nine inches long for a mallet, is capable of doing very delicate work, and also much which at first sight would seem to be entirely too heavy for so light a tool.

For reaching into the deeper cavities a No. 12 knitting needle, well set into an awl handle, is needed, while for cleaning out the carapaces of turtles it is well to have special long handles made. Darning needles are of convenient size but of too poor a quality of steel.

But whatever needle is used, a good oil-stone should always be at hand to renew the point as often as it is blunted. By a little practice a point can be put to a needle much better for this work than the original one.

A good stiff tooth-brush is needed, a good lens, say Tolles' one inch triplet, and a hand mirror to throw light into cavities of heavy specimens that cannot be easily turned.

A high workbench with vise, plyers, anvil and hammers, drills, a flat cushion to lay specimens on while being worked, and an assortment of wire complete the "kit" of tools, but a pot of mucilage and a box of calcined plaster are also needed for mending the broken. It is best to have always a number of specimens on hand so that the mended can be allowed to dry without delay to the work.

Of the cements that we have tried at Princeton, we have given up all but the one which we began with, recommended to us years ago by Professor R. P. Whitfield, and published by me in the *Am. Jour. Pharmacy*, May, 1875. It is: Starch one part

white sugar four parts, gum arabic eight parts and water q. s., boiled together after the manner of an apothecary. Latterly we have added a small quantity of salicylic acid to prevent fermentation. It should be about as thick as honey, and for joints that do not fit neatly it is well to thicken it at the moment of using with plaster of Paris. For filling large voids plaster enough should be kneaded in to make a stiff putty, and it is well to work in with it as many pieces of stone or brick as possible, both to save material and to lessen the shrinkage of the mass.

Although I sometimes paint the masses of plaster which show themselves, to destroy the unpleasant violent contrasts of color, I always use some neutral tint entirely different from the color of the fossil, in order that the false parts can be easily distinguished.

With the outfit described, a smooth-grained and moderately hard matrix and good hard bones the work is pleasant and easy. But when the matrix is of cemented gravel, here hard as flint, there loose sand, with soft and crumbly bones, a large stock of patience and good temper must be laid in also.

When the bone is freed from the matrix and mended, the question comes up as to how to keep it safely and show it to advantage. If economy of space be important, a drawer just deep enough to receive it is perhaps the best receptacle; but if we wish to exhibit it to the public a glass case is needed.

To ordinary observers, and even to pretty fair anatomists, bones on a tray or shelf say little. In a museum the inexpert visitor must, for obvious reasons, be considered as well as the student and professor, and experience shows that a bone in its natural position, even if alone, is easier to understand than when reversed, while if several bones are combined so as to form a foot, or leg, a spinal column or a skull, the value of each is greatly increased. Following out this idea I have been led to mount every skull, or limb, or bone, or even fragment of a bone which has character enough to be worth preserving, and have obtained results better than my hopes.

A single ramus of a lower jaw lying on its side in a tray shows but badly, and is liable to be thrust aside and jostled, to the great danger of its teeth and coronoid. But hold it in its natural position, and note its length and width. Then have a neat block of some hard wood, say cherry or black walnut, cut and polished

with shellac, not varnish, and selecting a wire of suitable size, make two hooks, like Fig. 1, to fit the jaw near its ends, set them up in the block, slip the jaw into them and it speaks for itself, and is safe. Of course the block must always be just so large that no part of the bone will overhang the edge, and then the specimen will not be injured by crowding it against the wall or another specimen. If larger than needed it wastes shelf-room. If the specimen be large and heavy, or at all crumbly, the supports need to be wrapped with cloth or felt to protect it.

Fig. 1

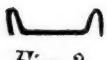

Fig. 2

Suppose we have both rami, or the greater part of them. Mend the breaks with the cement, and when dry bend two stout wires as in Fig. 2, one to bind the jaws together at each end, cement them in place and let them dry. Then set up three wire hooks to receive these braces, as at *b* and *c*, Fig. 3, one in front and two behind, as far apart as the jaw will allow. The use of these hooks is so obvious that the most careless or dull student can hardly fail to see it, which is a good thing, because if a

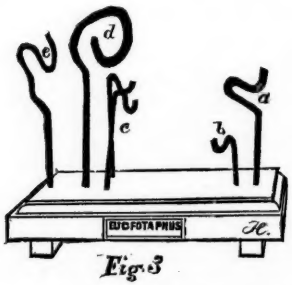

Fig. 3

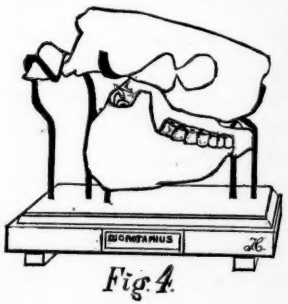

Fig. 4

Skull and atlas, eight and a half inches long.

blunder be possible some persons can always be depended on to make it, and hence come many breakages. If beside the jaw we have the skull, we need two more wires, one to catch the back of the skull at the glenoids (Fig. 3 *d*), and the other to support the nose (*a*).

In this specimen the sixth wire (*e*) carries the atlas, as shown in Fig. 4. When it came from Dakota it was a solid block of stone with corners of the bone sticking out, and it was worked apart entirely with needle and mallet.

Take another case (Fig. 5). Here are almost all the parts of Hyænodon's hind leg and foot, with part of the pelvis, a chaos as they lay in a tray. But by first glueing the tarsals together in position and making them a bed on a plaster base, and then bedding each metatarsal and phalanx in turn, I was able to display the foot. The tarsals were then set free by soaking in water. Fastening this plaster base to the black walnut pedestal by a screw-bolt, I set up behind it a post, eighteen inches high, into which wires were set, as shown in the figure. The small figures behind show the wires as seen from above "in plan." The main curves in *a* and *b* hold the tibia and their ends catch the fibula. Patella sits in the loop of *c*, *d* and *e* steady the head of femur, while *f* and another wire behind the post hold the pelvic fragment. Each bone is marked with the museum number of the specimen somewhere on its surface.

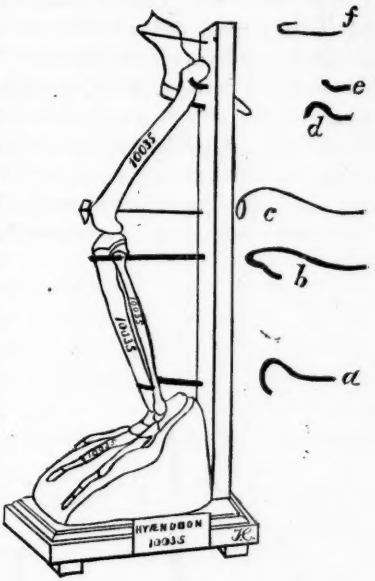

FIG. 5.

The adjustment of these wires is a nice matter. Each bone must have its natural position, but must be under no strain; must be held in its place securely, and yet be so free as to be easily lifted out. It must stay by gravity only.

For small specimens all that is needed to secure the wires in the pedestal or post, is to bore a clean hole a trifle smaller than the wire and force the wire into it, taking care not to turn it in the hole afterwards. For heavier bones, where wire of one-eighth inch and over is used, it is better to cut a thread on the wire and screw it in.

Some practice is needed to bring the wires to their proper shape. No two bones are ever quite alike, and hence each wire

must be fitted to its own place by experiment. When a new curve is put into one end of a crooked wire the path of the other end through space defies mathematics.

With heavy bones it is sometimes hard to make them rest in their supports without strain, though it can be done. We have an enormous femur of a mastodon which seems to be held up by a post behind it, while really the whole weight is borne by a plaster base in which the condyles rest, and the upper end does not even touch the post or the guard wires. The hind leg of Loxolophodon is mounted on a plaster base of the computed height

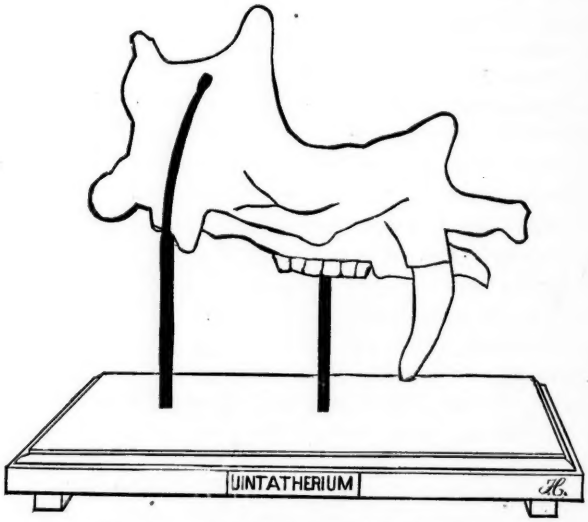

FIG. 6.—Skull, thirty-one inches long.

of the foot, which takes so much of the weight that there is no strain on the rod which guards the head of the tibia.

We have now five mounted skulls of the Uintatherium family, and their mountings give a fine example of evolution. The first one is sustained by five distinct iron rods whose flat feet are secured by sixteen screws to a painted pedestal of white pine, the irons weighing over eight pounds.

The last one, a much larger and finer specimen, is carried by two rods screwed into the black walnut pedestal. The rearward rod (Fig. 7) sends off a branch from each side just below the

felted saddle in which the basioccipital rests, which branches curve upwards and press against the bases of the rear horn-cores, so-called, and hold all firmly in place. The front iron has a small square button on top, felted, on which the roof of the mouth rests. These irons weigh four pounds.

While it is of course impossible to fix a maximum for the size of pedestals, a minimum is a good thing to have, and I have fixed on 3 in. × 1½ in. × 1 in. high. This gives room for a good sized label on the side, giving genus and species, geological formation, locality and catalogue number.

For very small jaws, single small teeth, &c., I set up a small cylinder of plaster on one of the smallest pedestals, and cement the specimen to the top of it. In other cases, as in *Didelphys pygmæa* Scott, and the Aciprion jaws shown in Fig. 8, the slab of matrix is cemented to the surface of a board hung on two pivots, so that it can be tilted to either side for examination. And when a new specimen shows new features I devise a new mounting to suit them.

Fig. 8

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RECENT LITERATURE.

CROLL'S CLIMATE AND COSMOLOGY.[1]—In this volume of essays, Mr. Croll reaffirms his physical theory to account for the glacial climate in a way to command the attention of every geologist and in a manner which will attract the interest of the lay reader. The discussions relate to questions of the deepest interest, and the arguments used are certainly strong ones. Mr. Croll's peculiar views as to the existence of glacial climates before the Quaternary period are restated with much fullness, though he candidly admits that most geologists are opposed to them.

The author's theory is usually called the "eccentricity theory," but he prefers to call it the "physical theory." He states that a high state of eccentricity of the earth's orbits will not necessarily

[1] *Discussions on Climate and Cosmology.* By JAMES CROLL, LL.D., F.R.S. New York, D. Appleton & Co., 1886. 12mo, pp. 327. $2.

alone produce a glacial epoch, but that from the first he has "maintained that no amount of eccentricity, however great, could alone produce a glacial condition of things," but that "the glacial epoch was the result, not of a high state of eccentricity, but of a combination of physical agencies, brought into operation by this high state" of eccentricity. One of the most important of these agencies is, he thinks, the enormous amount of heat conveyed from equatorial to temperate and polar regions by means of ocean currents, and the deflection of this heat, during a high state of eccentricity, from the one hemisphere to the other. But all this depends on ocean-currents flowing from equatorial to polar regions, and the existence of these currents, in turn, depends, to a large extent, on the contour of the continents and the particular distribution of sea and land. Take, as one example, the Gulf stream, a current which played so important a part in the phenomena of the glacial epoch. A very slight change in geographical conditions, such as the opening of communication between the Gulf of Mexico and the Pacific, would have greatly diminished, if not entirely destroyed, that stream; or, as I showed on a former occasion, a change in the form or contour of the Northeast corner of the South American continent would have deflected the great equatorial current, the feeder of the Gulf stream, into the Southern ocean and away from the Caribbean sea. One of the main causes of the extreme condition of things in Northwestern Europe, as well as in eastern parts of America during the glacial epoch, was a large withdrawal of the warm waters of the Gulf stream, and this was to a great extent due, as I stated in my first paper on the subject,[1] to the position of Cape St. Rogue, which deflected the equatorial current into the Southern ocean. That a geographical distribution of land and water, permitting of the existence and deflection of those heat-bearing currents, is one of the main factors in my theory, is what must be obvious to every reader of Climate and Time."

Dr. Croll maintains that, with the exception of those resulting from oscillations of sea level, the general distribution of sea and land and other geographical conditions were the same during the glacial epoch as they are at present. Thus he does not accept Lyell's theory of an elevation of northern lands; yet we do not see but that this was a matter of fact. Indeed, Mr. Croll's speculations produce the impression that he is somewhat one-sided in his treatment of these theories. His knowledge of general geology, and especially of palæontology, is apparently slight. For as regards his theory of interglacial climates in times preceding the Quaternary, the view is opposed to the whole mass of facts in palæontology. The more we have read of Dr. Croll's eccentricity theory, the less necessary does it seem; the geologist had better

[1] Philos. Mag. for August, 1864.

rely on purely geological causes; they may yet be proved to have been sufficient. Dr. Croll nowhere explains why so large a portion of the subpolar regions were unglaciated.

In his discussions in cosmology, Dr. Croll contends that Sir William Thomson and others are wrong in maintaining the "gravitation theory," *i. e.*, that the sun cannot have supplied the earth with heat, even at the present rate, for more than about 15 to 20,000,000 years. He discards this theory, and freely gives the evolutionists and geologists all the heat they want, by claiming that the sun's heat was originally derived from motion in space; this being "more in harmony with the principles of evolution than the gravitation theory, because it explains how the enormous amount of energy which is being dissipated into stellar space may have existed in the matter composing the sun untransformed during bygone ages, or, in fact, for as far back as the matter itself existed."

On page 65, Dr. Croll, it seems to us, too hastily assumes that the ice in the interior of Greenland is of great thickness, while the land itself is low, "probably not much above sea-level." On the contrary, as the result of recent Danish exploration, Dr. Rink tells us, the surface of the ice in the interior is 6000 feet above the sea, while we infer from his statements that the thickness of the ice is not much over 2000 feet. In fact, the theoretical glacialists go to extremes; closet speculations and field-work do not always harmonize.

The only typographical errors we have noticed are the mention of "Heyes" for Hayes on one occasion, while Torell is wrongly spelt "Torrell," in the only instance in which it is used.

LEUNIS' SYNOPSIS DER THIERKUNDE.[1]—This is a new edition of Leunis' Zoölogy, which for so many years has been in almost universal use in the German gymnasia and many of the universities. The present work contains two large volumes of more than 1200 closely printed pages and 1000 cuts each. Perhaps the greatest advantage of Leunis' system was that by the use of series of analytical keys animals could be determined much as the student analyzes flowers with Gray's Botany. This alone would render the book invaluable to any one who wishes to begin the study of a new group or to determine quickly an animal belonging to an unfamiliar class. The book is, of course, intended for German students, but is also quite complete for the marine invertebrates of the North, Baltic and Mediterranean seas. But it contains representative species of most of our American genera. Professor Ludwig, whose work on Echinoderms is known by all zoölogists, has revised the edition and has completely rewritten the second volume, which treats of the inverte-

[1] Third edition, revised by Professor LUDWIG, of Giessen.

brates. This is itself a sufficient guarantee of the scientific accuracy and value of the work. The analytical tables are brief and concise, yet not more technical in language than is absolutely necessary and can be readily understood and followed by the average student. But the book is no mere analytical key to the animal kingdom. The anatomical character of each type, class and order are briefly but clearly presented. It is a hand-book which every teacher will find useful in his class-room and laboratory and which is worthy of a place by the side of Claus or Carus and Gerstæcher in every zoölogical library. The style is clear enough, so that the book could easily be translated by any one tolerably familiar with German. The cuts are clear, good and well selected. The type is rather small and the paper thin, but if large type and thick paper had been used, we should have four or five volumes to contain what is now by a marvel of compression crowded into two. Even more marvelous than the condensation is the price, only thirty marks for the two volumes.—*J. M. Tyler.*

Beddoe's Races of Britain.[1]—This work gives the fruits of a continued examination of the complexions of large numbers of the natives of Britain, with a view to ascertain the proportion in which the various races, aboriginal and immigrant, are represented in the present population. The volume is to a great extent an expansion of a manuscript essay which in 1868 carried off the great prize of the Welsh National Eisteddfod, and is the outcome of a great part of the leisure of fifteen years. The method adopted was to take notes of the colors of the hair and eyes of persons met or passed at a sufficiently small distance to permit of observation. Those under age, those whose hair had began to grizzle, and those who seemed to belong to the upper or migratory classes were neglected. Eyes are distinguished as light, neutral and dark; hair as red, fair, brown, dark and black; and an index of nigrescence is adopted, forming a basis on which the results of the observations are mapped so as to speak to the eye. A considerable number of head-measurements were also made.

The book is a mine of information, bristling with statistics, facts and arguments, but unfortunately is scarcely comprehensible save by those who know nearly as much of the history and philology of the ancient races as does the author.

Zittel's Handbuch der Palæontologie.—We have from time to time drawn attention to this valuable work, which is being published in parts. It covers the plant and animal kingdoms, and is the most authoritative and recent work on the subject. Due credit is given to American work and illustrations. The number last received (Bd. I, Abth. ii, Lief. 4) is devoted to the fossil Crustacea,

[1] *The Races of Britain.* A contribution to the anthropology of Western Europe. By John Beddoe, M.D., F.R.S. London, Trubner & Co., Ludgate Hill, 1885.

including the trilobites and Merostomata. The illustrations are abundant and in most every case well engraved. The pages given to the Merostomata, the Phyllocarida and the lower Macrura are full and fresh in treatment. Each order is defined; a brief general account of the external anatomy follows, with remarks on the opinions of different authors as to their classification. The families and genera are defined, the leading types are figured, and then follow tables showing the geological distribution of the species. The author is usually critical in his mode of treatment, as seen in his doubtful recognition of Brachypyge as a Carboniferous crab, which, since the publication of this part, has been shown to be a pedipalp arachnidan. We do not see why, even in the light of Meek and Worthen's excellent treatment, Anthrapalæmon should be placed in the Penæidæ. Still the author's thoroughness and command of the literature is evident throughout the work.

FAXON'S REVISION OF THE CRAWFISH.[1]—This is a systematic treatise on the crawfish of the Northern hemisphere, based chiefly on the material in the museum at Cambridge, which now possesses all the known species from Europe and Asia, and all the American species, with three exceptions. The richness of the material may be realized by the fact that twenty new species of Cambarus are described, whereas Dr. Hagen, in his well-known memoir on the North American crawfish, described but ten unknown to previous authors.

The treatment of the material by the author, as may have been expected, is thorough, and the illustrations, drawn by Mr. Paul Roetter, are excellent. It is a matter of great interest to be able to study such a group as this, scattered as it is through the northern portions of the New and Old World. It is to be hoped that our naturalists will endeavor hereafter, in making out our American fauna, to compare it with that of Europe and particularly Eastern Asia.

GRABER'S ANIMAL MECHANICS.—This forms a double volume in a German series, entitled, Das Wissen der Gegenwart, devoted to popular knowledge relating to science, history and literature; each volume costing but a single mark or twenty-five cents.

The present volume is devoted to the mechanics of the external organs of vertebrates and invertebrates. The author is well known as an authority on the mechanics of motion, etc., of the Arthropoda and has given us what we have found to be a most useful and interesting volume, quite out of the ordinary line of works on natural history. It is abundantly illustrated with novel and graphic sketches, usually well drawn. The topics treated under Vertebrates are the mechanics of the

[1] *Memoirs of the Museum of Comparative Zoölogy, x, No. 4.* A revision of the Asticidæ. By WALTER FAXON. Part I. The genera Cambarus and Astacus. With ten plates. Cambridge, August, 1885. 4to, pp. 186.

external organs in general; the construction of the vertebrate machine and the chief levers; the mechanism of the jaws; the equipment of the jaws (teeth and beak); mechanism of the other mouth parts (tongue, lips, trunk and muzzle, muscles of the ear); the limbs, especially the human hand; and the limbs as organs of locomotion. In treating of the invertebrates, the modes of locomotion, of mastication, stinging, etc., are discussed.

FRENCH'S BUTTERFLIES OF THE EASTERN UNITED STATES.—At length we have a handy book giving descriptions of all our Eastern and Southern butterflies. The work appears to have been faithfully done, the information given is elementary, and the clear type, simple language and excellent illustrations, with the preliminary account of the transformations of butterflies in general, the best mode of collecting, killing, preparing for the cabinet and of rearing them, render the book an excellent manual for the beginner. An analytical key and glossary also add to its usefulness.

The author is indebted to Mr. W. H. Edward's great work for nearly all the descriptions of the early stages, and follows the classification and nomenclature of that author.

The criticisms we have to make are slight. We would have preferred to have the specific names, at least those not derived from proper names, begin with a small capital, or, when lower case is used, in lower case type. The original engravings are excellent. We should like to have had a larger number of species figured. We trust this may be done in a second edition, which we feel sure will be soon needed.

GOVERNMENT PUBLICATIONS.—Major Ben. Perley Poore is the author of a ponderous quarto of 1392 pages, bearing the following title: A descriptive catalogue of the Government publications of the United States, September 5, 1774, to March 4, 1881; compiled by order of Congress; Washington: Government print, 1885. Inasmuch as the aborigines of our country have been the object of concern to the Government from its beginning, there has never been a year in which valuable ethnological publications have not been issued. The titles of these may be followed up in the volume itself chronologically, or in the index under the word Indian the reader may find at once what he wishes. Other anthropological publications of equal importance to those named, treating of slavery, immigration, treaties, tariff, are here pointed out by title. Indeed, the whole work is an index of anthropology. Fortunate will the student be who can secure through his senator or representative a copy of the descriptive catalogue.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*The Goajira Peninsula.*—F. A. A. Simons contributes to the Proceedings of the Royal Geographical Society an account of the Goajira peninsula, to the west of the Gulf of Maracaybo, in the United States of Colombia. This large peninsula appears to be tenanted only by less than 25,000 Indians, who are divided into several castes, and have some peculiar laws. Every Indian belongs to the tribe of his mother, and, if he injures himself in any way, he has to pay blood-money to his mother's relations for shedding the blood of his family, and tear-money to his father's relatives for the sorrow he has caused them. The southern part of the peninsula is a level, grassy plain; the northern, a country of volcanic hills, with three ranges, the highest about 2800 feet high. There are no perennial rivers on the peninsula, so that in summer—the greater half of the year—the only water is from wells and a few water-holes, natural or artificial. The weapons of the Goajiras are the bow and arrow, as well as the flint-lock and the rifle. Poisoned arrows are used to some extent. The poison is putrefied animal matter, and the arrow-head the barbed weapon of a sting-ray, so attached to the shaft that it will remain buried in the wound it has made.

American News.—Lieutenant H. F. Allen and Sergeants Robertson and Ficket crossed last year from the head-waters of the Atnah to those of the Sarranah, descended this river to the Yukon and the latter to the sea. The *Corwin* brought these travelers to San Francisco, and also took up Messrs. Garland and Beatty, two Englishmen who had crossed from the Mackenzie to the Yukon and descended the latter.

ASIA.—*Col. Prejevalsky's Journey.*—A letter from Col. Prejevalsky relates to his journey from Lob-nor to Khotan. The few people of Lob-nor are the last remnant of the natives of Lob, a city which was destroyed at the end of the fourteenth century. The Cherchen-daria is a shallow river, margined with a belt of bushes and herbs, all thickly covered with loess dust. The only tree is a poplar, thirty to forty feet high. Cherchen is an oasis upon this river, containing about 3000 people, who carefully cultivate some three to four thousand acres. Near by are the ruins of two ancient cities. Remains of buildings, clay cups, glass, burnt bricks, slag, beads, copper utensils, even gold and copper coins, ingots of silver and precious stones are found, as also coffins, the bodies in which are often well preserved through the excessive dryness of the climate. Nia and Kiria are the first in a series of oases which extends through Khotan and Yarkand to Kashgar, and then along the southern foot of the Tian-Shan.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Prejevalsky reports discontent at Chinese rule among the Mohammedan natives, and asserts that they long for a change of masters.

Asiatic News.—The Russians have commenced the Trans-Caspian railroad. It is opened nearly, if not quite, as far as Askabad, and is graded to Dushak, 150 kilometers farther. From this point, one branch will lead to Sarakhs, where it will connect with the English road from Quetta, through Afghanistan. The other branch will run north-east, crossing the Amu Daria and running through Bokhara to Samarcand. Merv, Samarcand and Bokhara are already connected by telegraph with St. Petersburg. ——The population of British Burmah in 1883 was 3,736,771. ——Mr. Needham and Capt. Molesworth have recently followed the Brahmaputra the whole way from Sadiya to Rima and state authoritatively that a river corresponding in size to the Sanpo falls into it, and that therefore the identity of the Sanpo with the Dijong may be considered as finally settled.——The Marshall archipelago, now under German protection, includes thirty lagoon islands, none of which rise ten feet above the sea. Coco-palms, pandanus and breadfruit form the vegetation, and a small lizard is the only native quadruped. The group consists of two chains, the eastern, or Ratack, and the western, or Ralick. In the latter series is situated the largest island of the group, Jaluit, which has an area of about thirty-five square miles, and contains a good harbor.——A recent eruption in the neighborhood of Tonga has upheaved an island of nine square miles in extent in the space of four days. A party who visited the island in a schooner on October 17th, report that a submarine volcano upon the shore of the new island was throwing up an enormous quantity of steam and water. The island has already been named Takaogo, is sixteen to twenty miles north-west of Henga-Hapai, and rises 200 to 300 feet above the ocean surface.

AFRICA.—*British and German Protectorates.*—The Kalahari desert and the whole of Berlmana land were, on March 23, 1885, proclaimed to be under British protectorate. This protectorate includes all the territory lying east of 20° E. long., west of the Transvaal and Orange river republics, and south of 22° S. lat. The Boer republics of Goshon and Stellaland are embraced within this area.

The British protectorate of the Niger districts comprises the territories between Lagos and the right or western river-bank of the mouth of the Rio del Rey. It also includes the territories on both banks of the Niger as far as its confluence with the Benue at Lokoja, as well as the territories on both banks of the Benue, up to and including Ibi. Ibi is about 230 miles above the confluence of the Niger and Benue. Great Britain has agreed not to acquire territory, accept protectorates, or interfere with the extension of German influence to the eastward of a line following the right

river bank of the Rio del Rey to its source, then striking direct to the left river bank of the Old Calabar or Cross river, and terminating after crossing that river at the Rapids in about 9° 8′ E. long. Germany has agreed not to interfere to the west of the above line. Both powers relinquish any existing protectorates within the limits of the territories assigned to each, except that Victoria, Ambas bay, will still continue a British colony. Germany also engages to refrain from making acquisitions of territory or establishing protectorates on the coast between Natal and Delagoa bay.

African News.—M. de Brazza reached Paris November 12, 1885. He states that the whites and natives of the territories belonging to France are on the best of terms. Natives are being recruited to form an army.——The government of the Congo State has commissioned several geographers to execute maps of the entire State. Lieut. Massari is surveying the right bank of the Congo between the Alenia and Mobangi.——M. L. de Guiral is engaged in exploring the San Benito, about seventy miles north of the Gabon. The river is navigable only for twenty-two miles. There is a small lake eighty-seven miles from the coast, and three tributaries enter the San Benito above the first falls.

EUROPE.—*European News.*—A search for the true source of the Danube seems strange at this late date; yet M. de Wogan has found that it does not rise, as has been stated, in the gardens of the Prince of Fürstenburg, at Donaueschingen. It is formed by the union of two small streams, the Brig or Brigach and the Breg or Bregach. The first rises at Saint Georges, north of the Tryberg mountain and about a mile from the source of the Neckar, while the second rises at St. Martin, west of Tryberg and twenty miles from Donaueschingen, where the two streams unite.——The range called Umb-dek, in the Kolu peninsula, about a thousand meters high, is the highest land in European Russia north of the Caucasus.——Bosnia and Herzegovina have increased fifteen per cent in population between 1879 and 1885. The population at the latter date was 1,336,101.

GEOLOGY AND PALÆONTOLOGY.

THE VERTEBRATE FAUNA OF THE TICHOLEPTUS BEDS.—In the Report of the U. S. Geological Survey of the Terrs., Vol. III, p. 18 (1885), I have given some of the characters of this horizon and its fauna. It is intermediate in all respects between the Middle and Upper Miocene formations of the West, as represented by the John Day and Loup Fork beds. It was first explored in the valley of Deep river, Montana, by my assistant, J. C. Isaac, and afterwards by J. L. Wortman on the Cottonwood creek, Oregon. At the latter locality it is seen to rest on the John Day beds, as stated by Mr. Wortman, and as indicated by the collec-

tions made by him. The following species were found at the latter locality:

Protohippus, ? sp.
Hippotherium seversum Cope.
" *sinclairi* Wortman.
" *occidentale* Leidy.
Anchitherium ultimum Cope.
Dicotyles condoni Marsh.
Protolabis transmontanus Cope.
Merycochœrus obliquidens Cope.
Blastomeryx borealis Cope.

Considerable interest attaches to the discovery of an Anchitherium and of a Merycochœrus at this locality, as these genera ally the epoch to the John Day period, while Hippotherium, Dicotyles and Protolabis are Loup Fork genera.

The *Anchitherium ultimum* is represented in my collection by a nearly complete superior dentition, with palate and sides of skull to the middle of the orbits, and top of skull to above the infraorbital foramen. The size is less than that of the *A. præstans* Cope and *A. equiceps* Cope (*? A. anceps* Marsh) of the John Day bed, and the dental series has the same length as that of the *A. longicriste* Cope, also of the John Day.

It is in the cranial characters that this species displays the greatest differences from the John Day species. In the first place there is a profound and large preorbital fossa, separated from the orbit by a vertical bar. The preorbital fossa in the John Day species is shallow, and not abruptly defined. In the next place the anterior border of the orbit is above the anterior border of the last molar tooth. In this it agrees only with the large *A. præstans;* in the *A. equiceps* and *A. longicriste* the anterior border of the orbit is above the anterior part of the second superior molar. Thirdly, the infraorbital foramen is above the middle of the fourth premolar; it is over the posterior part of the third in the three John Day species. Finally, the nareal notch marks the anterior two-fifths of the diastema; it extends much further back in the John Day species, marking either the front or middle of the first premolar. The palate extends about as far anteriorly as in *A. præstans,* viz., to opposite the posterior border of the first true premolar.

The *Merycochœrus obliquidens* is smaller than any known species of Merycochœrus, about equaling the larger individuals of *Oreodon culbertsoni.* The molar teeth are, however, relatively larger than in that animal, and in the species of Eucrotaphus, and the anterior premolars and incisors smaller and more crowded. The last two premolars are in line, but the second premolar is set obliquely in the jaw so as to overlap the first premolar by the whole of its anterior root, and the third premolar by half of its posterior root. The anterior root is interior, the posterior exterior. The first premolar has a robust root with round section. The crown is but little expanded at the posterior base; anterior part and apex lost. The alveolus of the canine diverges some-

what outward. The symphyseal suture is short and rather deep. Its posterior edge is below the posterior quarter of the third premolar.

In the *Merychyus pariogonus* Cope of the Deep River Ticholeptus bed, the posterior part of the ramus is more expanded, and is perfectly rounded, while the other dimensions are considerably smaller.

Full descriptions of these species are given in a paper read before the American Philosophical Society, Feb. 19, 1886.

The species of the Ticholeptus beds of Montana are the following:

Mastodon proavus Cope.
Protohippus sejunctus Cope.
Merycochœrus montanus Cope.
Merychyus zygomaticus Cope.
" *pariogonus* Cope.
Cyclopidius simus Cope.
Cyclopidius emydinus Cope.
Pithecistes brevifacies[1] Cope.
" *decedens* Cope.
" *heterodon* Cope.
Procamelus vel Protolabis, sp.
Blastomeryx borealis Cope.

The only species common to the two lists is the *Blastomeryx borealis*, a fact which indicates some important difference in the horizons, either topographical or epochal. The Oregon specimens consist of teeth only, from both jaws, which are identical with those of the three crania known from Deep river. This animal is one of the deer-antelope, with persistent horns and deer-like dentition. Its horns are long and stout, and have a wide basal expansion above the posterior part of each orbit. It is about as large as the black-tailed deer.

The Ticholeptus horizon is interesting as that in which the genus Mastodon makes its first appearance in America. It is now shown to be the last which contains the genus Anchitherium.—*E. D. Cope.*

SCUDDER'S FOSSIL INSECTS.—Mr. S. H. Scudder has contributed to Zittel's Handbuch der Palæontologie, now being issued in parts at Munich and Leipzig, a very valuable résumé of our knowledge of fossil tracheate Arthropoda, with abundant and excellent illustrations in the text. In accordance with the treatment in other parts of the work, the classes are first defined, also the orders and families, while the genera are less briefly diagnosed and the leading species mentioned, or where the species are numerous the number of known fossil ones given. In the myriopods American forms predominate, while among the Arachnida more European species are known. The tables of geologi-

[1] The absence of caries in the teeth of extinct Mammalia is well known. The type specimen of the *Pithecistes brevifacies*, however, displays a carious excavation on the external side of one of its interior molars. This feature adds to those which indicate the degeneracy and approaching extinction of this type, as I have remarked in my synopsis of the Oreodontidæ, Proceedings American Philosophical Society, 1884, 557.

cal distribution of both myriopods, Arachnida and insects are of much value.

The class of insects begin with the Palæodictyoptera, which embrace all the Palæozoic insects, and is regarded as equal in rank with the Heterometabola (Orthoptera, Neuroptera, Hemiptera and Coleoptera).

The principal forms are well illustrated. As a provisional arrangement the Palæodictyoptera, as thus limited, may serve a temporary purpose, but the wonderful discoveries of Brongniart at Commentry, in France, seems to us to forbid the adoption of such a division, and to favor Brongniart's view that many of them, except Eugereon and possibly others, are simply Palæozoic genera of existing orders of insects, *i. e.*, representatives of distinct and extinct families, rather than of lost orders. But Brongniart's discoveries were not placed in the hands of the scientific public until after the work before us was mostly in print. Some of the divisions, as the Coleopteroidea, for the unknown manufacturer of the holes attributed to Hylesinus by Brongniart, seems unnecessary. Why the Thysanura should be placed as a "family" of the suborder Pseudoneuroptera is inexplicable to us, now that their structure is so well known.

But however one may differ from the author in matters of classification, he can not fail to note the care, labor and learning which has been bestowed upon this excellent and most useful summary.

Oscar Schmidt on the Origin of the Domestic Dog.[1]—We must now refer to the question of the origin of the domestic dog. That the whole line of foxes has nothing to do with the dog has long been an established fact. On the other hand Darwin endeavored to prove that various wild tribes of men in different parts of the globe tamed native wolf-like animals, and that the crossings of these species and breeding of various kinds produced the domestic dog of our day. This opinion of Darwin has been somewhat modified by L. H. Jeitteles, a careful authority on the domestic animals. According to him the wolf (*Canis lupus*) has no connection with the European and west-oriental races of dogs, the connection being mainly through the *jackal* and the *Indian wolf (Canis pallipes*). The races partly lead back into prehistoric times. Closest to the jackals we have the so-called *turf-dog*, known from the turf deposits of the lake-dwellings, and which is probably the ancestor of our Pomeranian dogs. Allied to it we have the terriers and turnspits. From *Canis pallipes* is descended the so-called *bronze-dog*, which most probably came to Europe with human immigrants from Asia, and with it the sheep dog of Central Europe, the larger sporting dog, the poodle, cur-dog and bull-dog. The ancestor of a third group may perhaps be found in the large jackal (*Canis lupaster*) of North Africa, to which we

[1] The Mammalia in their relation to primeval times. New York, D. Appleton & Co., 1886.

should also have to refer the ancient *Egyptian-dog*, the Oriental *street-dog* and the *wild dog of Africa*.

This does not as yet settle the question as to which fossil forms may be concealed among the numerous races of the domestic dog. Various conjectures have been made, none of which, however, are based upon any special reasons. According to Blainville's opinion, a diluvial species of a gentle and sociable nature—no longer existing in a wild state—must have been the primeval form of the domestic dog; but after what has been said above, this general way of settling the question must be regarded as one that no longer holds good. Woldrich's views show a greater amount of probability, and have lately been taken up again; he maintains that our domestic races are descended from several wild forms of the Canidæ of the Diluvium, and herein he agrees with what Darwin and Huxley have stated regarding the relation between the domestic dog and the living jackals and wolves.

It may with certainty be maintained that the direct ancestors of the European wolf are to be found in the Diluvial deposits. Formerly a huge animal of the wolf species was distinguished as the *cave-wolf*, without there being any distinct character to separate the two forms. A third form of wolf (*Canis suessii*, from the löss near Vienna) is described as a slim but powerful animal, strong enough even to pursue and overpower the larger species of plant-eaters. It is, in fact, one of the eight species of wolves which can be distinguished during the Diluvial early ages of man. And in addition to these there are about five kinds of foxes.

In now returning to the living Canidæ, several species demand our attention, one of which is described as *Icticyon venaticus*, a native of Brazil, the other under the generic name Cyon, inhabiting the countries to the north and north-east of the Altain mountains. These dogs do not possess the third molar in the lower jaw, and the molar tooth in the upper jaw is so small that a reduction appears to be imminent there as well. It is in the natural course of things that one or both of the first premolars, or the last molar, should become useless and forced to disappear by the neighboring teeth being specially taken into requisition, although in most cases we do not know the immediate reason of this.[1] The other circumstances of the structure of this group do not lead us to expect anything special from this concentration of the dentition. In former times, however, as we shall soon see, a most varied de-

[1] Any of our readers who can examine the head of a dachshund may convince themselves of the fact that the first premolar above and below can scarcely be of any use to the animal; it is a little stump which does not come in contact with the opposite row of teeth, and is frequently wanting altogether. If the dachshund is not forcibly suppressed as a species, its dentition will one day inevitably be reduced by one premolar.

velopment of new genera of beasts of prey began with dog-like animals.

Much more interesting for the purpose of our investigation here is the *Otocyon lalandii*, the spoon-dog of South Africa, so called from the peculiar formation of the skull. Its habits show an approximation to the foxes, yet as regards dentition it does not show this affinity, inasmuch as it possesses $\frac{4}{4} : \frac{4}{4}$ molars, and also shows the most remarkable differences in the relative size of the single teeth. As already said, the spoon-dog is, in many ways and as regards dentition, shaped after the fashion of the dog type, and can thus scarcely be dragged out of this connection, and we are compelled to look upon it as a still existing primary form of dog. The whole palæontology of the vertebrates shows that the many-toothedness of mammals is an inheritance from their lower ancestors, and that any increase of the teeth within a class has probably never taken place.

As our dogs, with their $\frac{2}{3} : \frac{2}{3}$ molars, have no doubt been descended from fuller-toothed animals, Otocyon must be regarded as the still-living representative of the early type of dog, which in other characteristics shows more affinity to the fox genus. But as there also exist species of the group *Canis azaræ* with very small frontal depressions, it is, as Huxley says, very difficult not to imagine that these too must be traced to ancestors of the Otocyon type. From this species, therefore, we should have to derive the two lines which diverge into the fox on the one hand, and the wolf on the other. We are supported in this view by the observation that the South American *Canis cancrivorus* often possesses the fourth molar, and thus shows itself to be another remnant of the primary form. A fourth supernumerary molar of this kind is not a monstrosity or pathological phenomenon, but an atavism or reversion of the same sort as the so-called wolf's tooth in horses, which was explained as a premolar which existed in the primary genus Anchitherium.

Hence the key to the derivation of all the dog tribe is to be found in their relation to the spoon-dog.

Geological News.—*Silurian.*—S. G. Williams, in a communication to the February number of the *American Journal of Science*, states that rocks of the Lower Helderberg period, including all above the water-lime group, are represented in New York, as far west as Cayuga lake, by limestones not less than sixty-five feet thick, containing an unmistakable Lower Helderberg fauna. Though fossils are rare in Cayuga county, fifteen species have been found, two or three of which are as yet undescribed, while the others all belong to Lower Helderberg species. Among them are two species of Strophodonta, *Rhynchonella semiplicata*, Stromatopora (most abundant of all), a Favosites and a Zaphrentis.

Triassic.—The geological age of the yellow sandstones lying north of the city of Elgin (Scotland) has been much debated, stratigraphists having maintained that they belonged to the Devonian (or rather Old Red sandstone), while palæontological evidence is in favor of their Triassic age. The Lacertilia are represented by Telerpeton, Hyperodapedon and an undescribed form, Crocodilia by Stagonolepis, and Dicynodontia by the type genus. Dr. Judd and Dr. Gordon have now procured good evidence that this reptiliferous sandstone passes down into a bed of conglomerate which rests unconformably upon the strata of the Upper Old Red sandstone. The conclusion is that during the vast periods of the Carboniferous and Permian, the Upper Old Red sandstone of the Elgin area was upheaved and denuded, and the Upper Trias beds deposited unconformably upon their eroded surface.

Jurassic and Cretaceous.—MM. Bertrand and Kilian, who have studied the Jurassic and Cretaceous strata of Andalusia, report that their composition is very like that of the same beds in the Alps. There are also many analogies between them and the corresponding beds of Sicily and of the Apennines, while the upper beds resemble those met with in the Balearic islands. The brachiopod beds of the Middle Lias and the ammonite beds of the Toarciari are met with alike in Sicily, the Apennines and parts of the Alps.

Quaternary and Recent.—M. Choper reports the existence of glacial beds in the French colony of Assinie, upon the coast of Guinea.——A letter from J. W. Dawson to *Nature* contains some interesting notes upon the causes of the purity of Nile mud. This mud, brought down chiefly by the Atbara and the Blue Nile from a country of siliceous and crystalline rocks, is, like that of the St. Lawrence, almost free from salt. It is also deficient in kaolin, (1) because the current of the river is sufficiently strong to wash into the sea all the more finely comminuted argillaceous matter; (2) because the older gneisses and schists do not kaolinize like Cornish granites, but crumble into sand, much of the feldspar remaining in a perfect state.——Professor Heim, known as one of the best authorities on glaciers, states that the motion of a glacier is, to a preponderating extent, the result of gravity. He enumerates partial internal liquefaction, caused by pressure; plasticity of the ice as it approaches the melting-point; ruptures and slight displacements, alternating with partial regelation and sliding on its bed, as sources of glacier motion. Glaciers merely smooth and very slightly wear away the previously existing rough surfaces, while streams and sub-aërial weathering have given valleys their form. The glacier is more of a carrier and rubbish-remover than of a delver and ploughman.

MINERALOGY AND PETROGRAPHY.[1]

HUSSAK'S "DETERMINATION OF ROCK-FORMING MINERALS."—The appearance in English of any book which treats of the methods of the new geology, is a subject for congratulation on the part of those who believe that the use of the microscope will reveal much of interest in the development of the earliest history of the earth's life. The importance of microscopical petrography is shown in the fact that the leading geologists all over the world are devoting much of their time to the study of the mineralogical characteristics of the rocks which form the solid crust of our globe and to the changes which these rocks undergo under various conditions. It is a lamentable fact that, though so much is now being done in this field, but few good English text-books exist. The only works relating to this subject which have appeared in English are Zirkel's Microscopical Petrography[2] and Rutley's Study of Rocks.[3] Both of these treat more particularly of the classification of rocks and presuppose a knowledge of the elementary principles, by means of which their mineral constituents are recognized. It is with pleasure that we now welcome a third volume, which treats of the optical properties of minerals and the methods which are made use of in their detection. Dr. E. G. Smith, of Beloit, Wisconsin, has very recently translated[4] Dr. Hussak's little book, noticed in the April number of the NATURALIST. Unfortunately, the first part of the translation, which treats of the methods of investigation, the optical properties, etc., of minerals, is marred by clumsy constructions, due to the literalness with which the original text has been followed. Most of the errors which the German petrographers have pointed out have been allowed to remain uncorrected. In many cases the choice of expressions for words and phrases occurring in the original are misleading. "The entering face of the light" is used for "Eintrittsfläche" (p. 18), "shell-formed" for "Schalenförmig" (p. 90), and "springlings" for "Einsprenglinge" (p. 85). A few words are mistranslated, and one (Kolben) is not translated at all. Certain sections of orthorhombic minerals are spoken of as not extinguishing "for the most part according to their axial figures" (Figurenaxen) (p. 23). More serious than these are the errors which arise from the confusion of the optical axes with the axes of elasticity; of biaxial minerals with those which are doubly refracting; and finally of isotropic substances with those exhibiting parallel extinction. The second part is taken up with a tabular arrangement of the principal minerals which enter into the composition of

[1] Edited by W. S. BAYLEY, Johns Hopkins University, Baltimore, Md.

[2] Washington, 1876.

[3] London, 1879.

[4] New York: John Wiley & Sons, 1886.

rocks. These are placed vertically in groups, according as their cross-sections are isotropic, or show parallel or inclined extinction. These groups are again subdivided in accordance with the crystallographic systems. Opposite the name of each mineral are placed its chemical composition, specific gravity, characteristic cleavages, the ordinary forms of its cross-sections, its twinning laws, the character and strength of its double refraction, its colors under crossed nicols, its natural color and pleochroism, its structure, the minerals with which it is generally associated, its characteristic inclusions and decomposition products, and those peculiarities which distinguish it from other minerals of the same general appearance. In this part an immense amount of material is so arranged that with very little trouble the student can turn to the mineral whose properties he wishes to study, and find in a few brief sentences the characteristics by which it can be distinguished from all others. This part will prove of considerable use to all who are beginning the study of petrography, and whom such manuals as that of Rosenbusch would tend only to confuse and discourage. A great service has been rendered to all those to whom the material in Dr. Hussak's book is inaccessible on account of the language in which it is written, and the translator deserves the thanks of all those interested in petrography for having placed within the reach of American students the elements of a branch of geology which is just beginning to be appreciated on this side of the Atlantic, as affording a key for the solution of many questions which have heretofore been considered as beyond the power of penetration.

PETROGRAPHICAL NEWS.—The relations of the bastite serpentine to the troktolite in the Belhelvie parish, in Aberdeenshire, are studied by Bonney, and the results of his investigations published in the *Geological Magazine*.[1] The serpentine is derived from an olivine-enstatite rock. The troktolite is a moderately coarse-grained mixture of purplish-gray or whitish feldspar and dull dark green serpentine. At the junction of these two rocks, it was found that every grain of olivine was surrounded by a reactionary rim. The sequence of the two rocks in respect to age is not satisfactorily decided. In the same paper, the "Black Dog" rock, first mentioned by Heddle,[2] as a mass of rock about four yards long and broad, which projects from the sand on the shore, is described as containing fibrolite, iolite, quartz and mica. It bears a very close resemblance to some of the cordierite gneisses of Bavaria.——Küch describes[3] a quartz-pyroxene-andesite from the Cumbal in the Andes, in which the pyroxene constituent is principally hypersthene, and remarks that this mineral is a much

[1] October, 1885, p. 439.

[2] Mineralogical Magazine, V, p. 1.

[3] Neues Jahrb. für Min., etc., 1886, I, p. 35.

more frequent constituent of the andesites of this region than has hitherto been supposed.——Quite an addition to our knowledge of the metamorphoric rocks has recently been made in the articles of Von Miklucho-Maclay[1] and Joseph Götz.[2] The former treats of the schists found on the River Witim, in East Siberia. These consist of altered gneisses, brown-spar phyllite, in which rhombohedra of brown spar are found enclosing all the other minerals, and even in some cases forming complete pseudomorphs of quartz, and brown-spar phyllite gneiss, which differs from the brown-spar phyllite in containing complete pseudomorphs of plagioclase after brown spar, and also in the enlargement of its quartz by the deposition of new quartz substance. Götz reports the results of his investigations on the rocks occurring in the neighborhood of the gold fields of Marabastad in Northern Transvaal. These he divides into gneiss, amphibole rocks, chlorite schists, phyllites, ottrelite and andalusite schists, quartzites, serpentine and proterobase. After a very careful study of the structure and mineralogical composition of all these rocks, he concludes that pressure is the cause of the schistosity of the schistose kinds, and that to this agency is due also the formation of the ottrelite and andalusite, which took place contemporaneously with the assumption of the schistosity. Thus much additional information is added to our knowledge of that sort of regional metamorphism, called by Lossen[3] dislocation metamorphism, to which so much attention is now being directed by the leading German petrographers.

Mineralogical News.—In a late number of the Neues Jahrbuch,[4] Max Bauer publishes the continuation of his studies in mineralogy. In this paper he describes pseudomorphs of calcite after aragonite from Klein-Sachsenheim, in Württemberg. In all instances of this kind heretofore described the rhombic substance of the aragonite was supposed to have undergone a molecular rearrangement and thus to have passed over into rhombohedral calcite. A study of the Klein-Sachsenheimer crystals and the mode of their occurrence shows, however, that in some cases at least, a solution and deposition takes place. These crystals are found in a drusy dolomite, which originally contained in it lens-shaped masses of gypsum. This gypsum has been removed by water, and it was from this solution that the aragonite was deposited on the sides of the hollows left.[5] At the same time, there was a deposition of brown spar, which covered the

[1] Ib., 1885, II, p. 145.

[2] Ib., Beil., Bd. IV, p. 110.

[3] Zeits. d. deutsch. geol. Gesellschaft, XXI, p. 324.

[4] Band I, 1886, p. 62.

[5] From very dilute solutions or from those containing small amounts of gypsum, calcium carbonate is deposited as aragonite, while from concentrated solutions or those containing no foreign matter it is deposited as calcite.

little crystals of aragonite and protected them from the dissolving action of fresh supplies of water. Wherever an imperfection in the covering allowed water to gain access to the aragonite substance, a concentrated solution of this was formed and the salt was redeposited as calcite. Its external form, of course, was occasioned by the shell of brown spar, which remained undissolved. In nearly every case studied, an internal kernel of aragonite was surrounded by an external covering of calcite, showing that the change took place from without. The author thinks that many other cases of paramorphism may be explained by supposing a solution and redeposition of the material in the same way as that described.——Davreuxite, hydrous anthophyllite and hydrotephroïte have recently been investigated by Lacroix.[1] The first he describes as having all the optical properties of a mica. It is biaxial, with a negative bisectrix. It occurs in little plates, mixed with quartz grains in the quartziferous veins in the schists at Ottré. Hydrous anthophyllite (from Glen Urquhart, Scotland) is not a homogeneous substance, but is composed of fibers of actinolite, cemented together by a substance belonging to the chlorite group. Hydrotephroïte is a mixture in various proportions of at least three different substances. That which occurs in greatest quantity is colorless and biaxial and is probably tephroïte. The other substances are serpentine, chlorite and various manganese minerals. The hydrotephroïte is probably an altered tephroïte or some other manganese silicate.——Beautiful rhombohedral crystals of calcite are described by R. H. Solly,[2] from the Tankerville mine, Shropshire, Eng. They contain only the rhombohedral and scalenohedral faces, with the former predominating. The scalenohedral faces are bright and are covered with little quartz crystals, while the rhombohedral faces contain no quartzes, but are dull and corroded.——Until very recently our knowledge regarding the blue "sulphato-chloride of copper," to which Dana in 1850 gave the name connellite, has been confined to the results of the investigations of Maskelyne[3] and Bertrand.[4] Lately, however, in consequence of the discovery of new material, the crystallography of the mineral has been thoroughly worked up. Connellite occurs in copper veins traversing clay slate and granite in the Camborne district, situated at the west end of the granite boss in which most of the productive tin mines in England occur. The mineral is not found massive, but only in aggregates of minute crystals, the largest measuring from two to four millimeters in length. In crystallization they are hexagonal, containing only the simple forms P, ∞P2 and ∞P, in addition to those observed by Maskelyne.——

[1] Comptes Rendus, CII, 1886, p. 273.

[2] Mineralogical Magazine, VI, May, 1885, p. 120.

[3] Philosophical Magazine, January, 1863.

[4] Bulletin de la Soc. Min. de France, 1881, IV.

Guejarite, hitherto known only from Spain, is mentioned by F. Sandberger[1] as occurring at Machacamara, in Bolivia, in radial aggregates in white quartz, associated with barite.——G. F. Kunz announces in a paper in the *American Journal of Science*[2] that the meteorite described by him at the last meeting of the American Association as the Charleston, W. Va., meteorite, fell on Jenney's creek, Wayne county, W. Va., and not, as before stated, at Charleston. It is described as a meteoric iron, made up of crystalline blocks of plessite and kamacite, and belongs to the "grobe Lamellen" of Brezina. An analysis yielded: Fe = 91.56, P = 0.13, Ni and Co (by difference) = 8.31.——The minerals of the region around Stempel, near Marburg, and those of the Erzgebirge have been pretty thoroughly investigated by Stadtländer,[3] of Lüneberg, and Schalch,[4] of Leipzig. The former thinks that the optical anomalies of analcite must be the result of secondary conditions which acted after the crystal had been formed.[5] He finds also twins of Natrolite in which the twinning axis is normal to ∞P and the composition face is the base.——In a little book entitled Die Chemische Natur der Mineralien,[6] Rammelsberg attempts a systematic arrangement of all the minerals, the analyses of which show them to have a constant composition.

Miscellaneous.—Improved methods for the detection of small quantities of silver, chlorine, selenium, sulphur, arsenic, antimony, barium, strontium, lithium and sodium under the microscope, are described by Streng in the last number of the Neues Jahrbuch.[7] The antimony is transformed into antimony chloride; a little of this is evaporated to dryness in an object glass, and the residue moistened with a drop of water holding barium tartrate in suspension and a little barium chloride in solution. On evaporation, little rhombic tables of barium antimony tartrate are found around the edges of the drop. A closer examination of these shows them to possess a monoclinic symmetry, with the forms oP, P and ⅓ P∞ best developed. A practical use of these methods is made in an examination of the composition of rittingerite and pyrostilpnite. The latter is found to be $Ag_3 Sb S_3$, the former $Ag_3 As S_3$ or $Ag_3 As (S. Se)_3$.

[1] Neues Jahrb. für Min., etc., 1886, I, p. 89.
[2] February, 1886, p. 145.
[3] Neues Jahrb. für Min., etc., 1885, II, p. 97.
[4] Ib., Beil., Bd. IV, p. 178.
[5] Cf. American Naturalist, 1885. March, p. 296; September, p. 886.
[6] Carl Habel, Berlin, 1886.
[7] 1886, I, p. 49.

BOTANY.[1]

BRANCHING OF OSMUNDA CLAYTONIANA.—In those ferns in which the vascular system of the stem consists of a ring of separate bundles, branches and leaves usually arise by an increase by division of the bundles, until a portion is deflected with surrounding tissue to the lateral member. The method in the Osmundas is not so simple. In Fig. 1, *A* shows a cauline bundle, *b b'*, in which an outer portion is being separated to form the bundle of a stipe, as at *C*. Two lateral portions, between this and what remains, are deflected to roots at each side of the base of the stipe which originate at the same time, as at *r r'*. The divisions which remain in the stem unite with similarly divided parts of adjoining

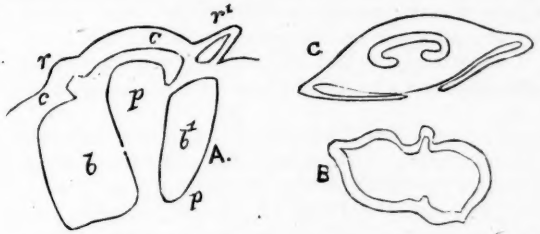


FIG. 1.—*A*, segment of cross-section of stem; *b b'*, a bundle dividing into a central outer portion, which enters a stipe, two lateral portions which enter the beginnings of roots *r r*, and two larger portions which remain in the stem; *p*, pit; *c*, cortex; *B*, section of stem below a fork, showing preparatory constriction; *C*, section of stipe, about an inch from the base, showing single large bundle. *A*, reduced from camera sketch, magnified ten, *B* and *C* about two diameters.

bundles, so that the number in the stem remains the same. From the condensed character of the stem, the vascular system at any section appears as a series of incomplete and variously united bundles.—*A. A. Crozier, Grand Rapids, Mich., Jan. 27, 1886.*

MOVEMENTS OF DESMIDS.—Herr G. Klebs describes (*Biologisches Centralblatt*) four different kinds of movements in the Desmidieæ, viz: 1. A forward motion on the surface, one end of the cell touching the bottom, while the other end is more or less elevated, and oscillates backwards and forwards during the movement. This is especially well seen in *Closterium acerosum*. 2. An elevation in a vertical direction from the substratum; the free end making wide circular movements (*C. didymotocum*). 3. A similar motion, followed by a sinking of the free end and an elevation of the end previously depressed, and so on alternately (*C. moniliforme*). 4. An oblique elevation, so that both ends touch the bottom; lateral movements in this position; then an elevation and circular motion of one end and a sinking again to an oblique or horizontal position (*C. dianæ* and *archerianum*). These move-

[1]Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

ments are none of them peculiar to particular species; several of them are often combined in one. A free swimming on the surface, like that of diatoms, was never observed.

The first two of these movements depend on the formation, during the motion, of a filament of mucilage, by which the desmid is attached to the bottom; the gradual lengthening of this filament, by the formation of fresh mucilage, causes the desmid to rise. The filament is best detected by a weak solution of methyl-violet or fuchsin, which does not kill the desmid. Cyanin also answers, but not so well. Other pigments do not stain it. Many species of Euastrum, Cosmarium, Staurastrum and Pleurotænium exhibit the same phenomenon. The greatest length of filament observed was $3^{mm.}$; the most rapid motion, in *Closterium acerosum*, 112μ in 30 sec.; many species are quite motionless. Light exercises an influence on the direction of the movement similar to that of zoöspores, but not on its rapidity. The elevation and depression appear to be independent of the direction of gravitation.

The author considers the cause of the motion to be the exudation of mucilage, which does not take place simultaneously and uniformly over the whole surface of the desmid. This formation of mucilage is not the result of disintegration of the cell-wall itself; it proceeds directly from the cytoplasm and passes through the cell-wall without the latter undergoing any change. Many species are completely surrounded by a gelatinous envelope, while others are comparatively free.—*A. W. Bennett, London.*

Pleomorphism of Algæ.—Dr. A. Hanszig publishes in the *Botanisches Centralblatt* an elaborate paper which has for its object to prove that a large number of algæ hitherto referred to the families Schizophyceæ or Cyanophyceæ, Chroococcaceæ, Oscillariaceæ, Nostocaceæ, Scytonemaceæ, Confervaceæ, Chætophoraceæ, Siphonocladaceæ and Ulvaceæ are but stages in the evolution of single forms. He describes the mode in which these various forms of algæ may develop one out of another, and he regards also the Schizophyceæ and Schizomycetes as connected together by insensible gradations. Thus we may have one and the same alga occurring in its mature form, and in its Stigonema, Leptothrix, unicellular, Nostoc, Ulothrix, and a variety of other forms. Euglena he regards also as genetically connected with the Phycochromaceæ and Oscillariaceæ. Dr. Hanszig refers to a new analogy between the Schizomycetes and Schizophyceæ by the discovery of a motile organism which he names *Chroomonas nordstedtii*, and which he regards as the swarm-cell condition of a phycochromaceous alga, probably an Oscillaria.—*A. W. Bennett.*

Tree Growth on the Plains.—From a recent paper on "Tree Planting on the Plains," by Robert W. Furnas, we extract the following statistics of the growth of trees, as shown by actual

measurement of trees of known ages. The measurements were made at the uniform height of two feet above the ground.

Common Name.	*Scientific Name.*	*Years Old.*	*Circumference. (Inches.)*
White Elm	Ulmus americana	15	24¾
Red Elm	Ulmus fulva	24	36
Osage Orange	Maclura aurantiaca	25	26¼
Soft Maple	Acer dasycarpum	18	54¾
" "	" "	18	69¼
Box Elder	Negundo aceroides	14	25¼
" "	" "	14	31⅛
Honey Locust	Gleditschia triacanthos	22	40¼
" "	" "	22	41½
Black Locust	Robinia pseud-acacia	24	60½
Kentucky Coffee tree	Gymnocladus canadensis	14	25½
Sycamore	Platanus occidentalis	16	43½
Black Walnut	Juglans nigra	22	48
" "	" "	22	50¼
White Walnut	Juglans cinerea	22	49¼
Shagbark Hickory	Carya alba	24	30
Chestnut	Castanea vesca, *var.* americana	14	24½
Burr Oak	Quercus macrocarpa	22	36⅛
White Oak	Quercus alba	22	29
White Ash	Fraxinus americana	22	32¼
Green Ash	Fraxinus viridis	22	30
Cottonwood	Populus monilifera	23	78¼
"	" "	23	93
White Pine	Pinus strobus	20	36¼
Scotch Pine	Pinus sylvestris	15	23
Austrian Pine	Pinus laricis, *var.*	15	22½

BOTANICAL NEWS.—Late numbers of *Annales des Sciences Naturelles* contain papers on the following subjects, viz: The actual state of our knowledge of the function of chlorophylline, Researches upon the development of the sporogone of the Hepaticæ, Observations upon the Santalaceæ, Researches upon the comparative anatomy of the stem of the Dicotyledons, Researches upon the variation of the respiration with the development of plants, The respiratory function of vegetation.——The more important papers in the sixteenth volume, just closed, of Pringsheim's Jahrbücher für Wissenschaftliche Botanik are Schimper's Investigations upon chlorophyll bodies, Tschirch's Contributions to a knowledge of the mechanical tissue systems of plants, De Vries' Plasmolytic studies on the vacuole wall, Reiche's Upon the anatomical changes in the perianth-whorl which precede the development of the fruit. This volume contains twenty-eight plates.——An interesting paper on intramolecular respiration, by W. Pfeffer, is just received. It is in continuation of work done by Dr. W. P. Wilson, of Cambridge, Mass.——A white-seeded variety of the honey locust is described

by Thomas Meehan in Proceedings of the Academy of Natural Sciences, Philadelphia, December 1. The tree bearing these anomalous seeds is of considerable age, and stands near Germantown, Pa.——A neatly printed Catalogue of the Phænogamous and vascular cryptogamous plants of Fitchburg [Mass.] and vicinity is worthy of note as being "the work of students of the Fitchburg high school." It is said to represent "about seven years of diligent research." It is a very creditable production, and indicates good work in the school.——The Fourth Annual Report of the Board of Control of the New York Agricultural Experiment Station, for the year 1885, appears with a most satisfactory promptness. Its contents show the continuation of the high class of work for which this station has been distinguished.——E. W. D. Holway, of Decorah, Iowa, has made out a set of genus labels of the fungi for use in herbaria. There are about 720 names, which represent, after deducting duplicates, from 500 to 600 different genera. The printing is done by H. N. Patterson, of Oquawka, Ills., which is a sufficient guarantee of the neatness of the typography.

ENTOMOLOGY.

On the Cinurous Thysanura and Symphyla of Mexico.—It was my good fortune during a short visit to Mexico in the spring of 1885, to discover the one insect which I scarcely hoped to find, so rare are the species and individuals in other parts of the world. This was *Japyx saussurii*, described and figured by Humbert in *Revue et Mag. de Zoölogie*, xx, 345, 1868. His descriptions and excellent figures were made from three specimens collected by M. Sumichrast at Santa Cruz, Moyoapam, near Orizaba. It was evidently hopeless to look for Japyx on the Mexican plateau in the dry season, if it lives there at all; though near Vienna *Japyx solifugus* occurs in dry, sandy places, where, in 1872, I had the rare pleasure of observing it under the kind guidance of Dr. Brauer. The Cinuran characteristic of the *tierra templada* is a species of Machilis, which was common under stones at Saltillo.

At Cordova, however, owing to the kindness of a Spanish gentleman, the owner of a coffee plantation, who allowed me the use of one of his laborers, an intelligent Indian, I found about a dozen specimens of *Japyx saussurii*, in the shaded damp coffee growth, which my Indian turned up with his hoe from the rich, black soil under fallen banana trunks and loose stones. They seemed to be comparatively common, and very active in their movements.

On comparing with it our northern *J. subterraneus* Pack., from Kentucky, our species is seen to differ decidedly from the Mexican in the much squarer head, which is broader in front; in the broader prothorax, and especially in the longer and narrower tenth abdominal segment. It also differs in the denticulations of

the blades of the forceps (cercopoda), the largest tooth on the inside of the left blade being situated nearer the middle. Our species is also smaller. The number of joints to the antennæ in *J. subterraneus* are 32; in the Mexican species 40.

Associated with the Japyx and in equal abundance was a Scolopendrella, which I at first supposed to be a different and larger species, but which, after a careful microscopical examination, I cannot separate from *S. immaculata* Newport. It has the same general appearance; and the form of the antennæ and number of antennal joints are nearly the same; there being 40–42 joints in the Mexican, and 35–36 in a Kentucky individual. The number of scutes behind the head is the same (16), and their shape exactly the same. The anal cerci are slightly longer than in United States specimens, but the fine setæ are the same in size and arrangement. The specimens are pure white and larger (5^{mm}) than any I have yet seen from the United States.

Campodea mexicana, n. sp.—While *Scolopendrella immaculata* seems to be common to Europe, the United States, and Mexico, and *Campodea staphylinus* Westw., likewise common to Europe and the northern United States, we discovered at Cordova, in company with the foregoing Synaptera, a very distinct species of Campodea, which is apparently characteristic of the *tierra caliente* or warm zone of Mexico.

It is a large species, the body $4^{mm.}$ or $7^{mm.}$ including the caudal stylets, being but little smaller than *C. cookei* Pack., of Mammoth and adjoining caves, but with much shorter caudal appendages. The body is shorter, the three thoracic segments being shorter than in *C. cookei*. The antennæ are of the length of the body and 28-jointed; the terminal joint is intermediate in shape between *C. staphylinus* and *C. cookei*, being slenderer than in *C. staphylinus*. Dr. J. S. Kingsley has discovered a sense-organ at the end of the last antennal joint of *C. staphylinus;* that of *C. mexicana* is slightly smaller, rounded oval, but situated near the middle of the joint; while that of *C. cookei* is larger than in *C. staphylinus*, but as in that species situated at the end of the joint; the joint in all three species is rich in nerve-cells. The caudal appendages are rather short, and composed of 7–8 long joints. There are other interesting differences from *C. staphylinus*, which, however, could not be understood without figures, which we have prepared, but reserve for a future occasion.—*A. S. Packard.*

The Locust in Southeastern Russia.—The Agricultural Academy in Moscow, has each summer for two years sent Professor K. Lindeman to Southeastern Russia to study the locusts ravaging that region, and the results of his travels have been published in two large works, one (1883) on the locust in the Danubian Cossack region, and the other (1886) on the locust in

the Kouban region. He writes to the editor of the *Entomologische Nachrichten* for Jan., 1886, that he has satisfied himself that the locust (*Acrydium migratorium*) is not peculiarly an inhabitant of the plains or steppes, but that preferably and originally the lower regions of the banks of rivers, where grow *Arundo donax*, Scirpus, etc., are its birthplace, from whence it flies out and visits the steppes. *Acrydium migratorium* is in his opinion purely a swamp insect. Its eggs retain their vitality even if the region in which they are laid has remained covered for months in the spring by the water of the river. The larvæ in their third stage are marked with red, because this color protects them in the swamp surroundings in which they live. A group of red locust larvæ, sitting on spears of grass, give the appearance of a group of rushes bearing red ears. The similarity is so great "that I myself sometimes at a distance could not distinguish whether the red spots in a swamp were a colony of locusts or a group of rushes."

ENTOMOLOGICAL NEWS.—In a paper on Parnassius, a genus of butterflies, read by Mr. H. J. Elwes at the meeting of the Zoölogical Society of London, held Jan. 10, the author paid special attention to the development, functions, and structure of the horny pouch found in the females of this genus. He also described the habits, distribution and variations of twenty-three species which he recognized in the genus. The paper was supplemented by Professor Howe's remarks on his examination of the anatomy of *Parnassius apollo*, and by Mr. Thomson's notes on the habits of the insects as bred in the society's gardens in 1885.——Dr. Witlaczil in *Zoölogischer Anzeiger*, Jan. 18, reaffirms against H. Wedde that the Aphides and Coccidæ suck their food in the same manner as Lepidoptera and other insects.——In the same number O. Poletajewa gives the result of his studies in the structure and function of the heart of insects, to which we shall call attention more fully hereafter.——Mr. A. D. Michael has described before the Linnean Society of London (Nov. 19), the remarkable nymphal stage of an Oribatid (*Tegeocranus cepheiformis*), during which the mite carries on its back as concentric shields the dorsal portions of all its cast-skins.——In the European myriopod, Sphærotherium, there is a well defined stridulating apparatus on the male claspers, which produces a shrill note like that of the house-cricket. A true auditory organ exists in the antennary fossa beneath the eye. The tracheal system is unlike the majority of that of the Diplopoda, rather resembling that of Chilopods and insects, though differing in the branched spiral filament not taking origin directly from the stigmata themselves.——A number of new species of American myriopods are described by F. Meinert in the Proceedings of the American Philosophical Society.

ZOOLOGY.

PHOSPHORESCENCE OF MARINE ANIMALS.—The address in Section D, biology, of the British Association, was delivered by Professor W. C. McIntosh, M.D., of St. Andrews, who selected for his subject, the "Phosphorescence of marine animals." A phenomenon so striking as the emission of light by marine organisms could not fail to have attracted notice from very early times, both in the case of navigators and those who gave their attention in a more systematic manner to the study of nature. Accordingly, we find that the literature of the subject is both varied and extensive—so much so, indeed, that it is impossible on the present occasion to give more than a very brief outline of its leading features. Though it is in the warmer seas of the globe that phosphorescence is observed in its most remarkable forms—as, for instance, the sheets of white light caused by Noctiluca and the vividly luminous bars of Pyrosoma—yet it is a feature which the British zoölogist need not leave his native waters to see both in beauty and perfection. Many luminous animals occur between tide-marks, and even the stunted seaweeds near the line of high-water everywhere sparkle with a multitude of brilliant points. As a ship or boat passes through the calm surface of the sea in summer and autumn, the wavelets gleam with phosphorescent points, or are crested with phosphorescent points, or are crested with light; while the observer, leaning over the stern, can watch the long trail of luminous water behind the ship from the brightly sparkling and seething mass at the screw to the faint glow in the distance. On the southern and western shores, again, every stroke of the oar causes a luminous eddy, and some of the smaller forms are lifted by the blade and scintillate brightly as they roll into the water. The dredge and trawl likewise produce, both in the shallower and deeper parts of our seas, many luminous types of great interest and beauty. He glanced, in the first instance, at the various groups of marine animals which possess the property of phosphorescence, and continued: It is found that this feature is possessed by certain members of the Protozoa, and by the following groups of the Metazoa, viz., cœlenterates, echinoderms, worms, rotifers, crustaceans, molluscoids, mollusks and fishes. In foreign seas many brightly luminous specimens are met with. Thus Professor A. Agassiz describes *Mnemiopsis leidyi* as "exceedingly phosphorescent, and when passing through shoals of these Medusæ, varying in size from a pin's head to several inches in length, the whole water becomes so brilliantly luminous that an oar dipped in the water up to the handle can plainly be seen on dark nights by the light so produced; the seat of the phosphorence is confined to the locomotive rows; and so exceedingly sensitive are they that the slightest shock is sufficient to make them plainly visible by the light emitted from the eight phosphorescent ambulacra." The

same author mentions that Lesueuria has a very peculiar bluish light of an exceedingly pale steel color, but very intense. Giglioli, again, found that the beautiful riband-like Cestus shone with a reddish-yellow light, but in Eucharis the latter was intensely blue. In the Chætopteridæ the phosphorescence is remarkably beautiful, bright flashes being emitted from the posterior feet. Marine phosphorescence has some of its most striking examples among the Tunicates. One of the best known instances is that of Pyrosoma, the light from which has been so graphically described by M. Péron, Professor Huxley, and other naturalists who have had an opportunity of observing it. It proceeds in each member of the compound organism from two small patches of cells at the base of each inhalent tube. Phosphorescence in living fishes appears to have been accurately observed within a comparatively recent date, though the luminosity of dead fishes has been known from very early times, and has been the subject of many interesting experiments, such as those of Robert Boyle on dead whitings, and Dr. Hulme on herrings. I do not mean to say that the literature of the so-called phosphorescent fishes is scanty, for it extends from the days of Aristotle and Pliny to modern times, but that the writers have had little reliable evidence in regard to living fishes to bring forward. Thus, of upwards of fifty fishes entered by Ehrenberg in his list it is hard to say that one is really luminous during life. In many cases it is probable that the supposed phosphorescence of large forms, such as swordfishes and sharks, has arisen from the presence of multitudes of minute phosphorescent animals in the water, just as the herring causes a gleam when it darts from the side of a ship. Professor Moseley, for instance, observed in the *Challenger* that when large fishes, porpoises, and penguins dashed through phosphorescent water it was brilliantly lit up, and their track marked by a trail of light. The same feature is observed in hooked fishes, and it is known that fishermen are doubtful of success when the sea is very phosphorescent, for the presence of the net in the water excites the luminosity and scares the herring. One of the most striking instances of phosphorescence in living fishes is that of the luminous shark (*Squalus fulgens*), found by Dr. Bennett. This is a small, dark-colored shark, which was captured on two or three occasions at the surface of the sea. It emitted without irritation a vivid greenish luminosity as it swam about at night, and it shone for some hours after death. The phosphorescence appears to be due to a peculiar secretion of the skin. The eyes of the shark were more prominent than usual in such forms. A survey of the life-histories of the several phosphorescent groups affords at present no reliable data for the foundation of a theory as to the functions of luminosity, especially in relation to food. No phosphorescent form is more generally devoured by fishes or other animals than that which is not; and, on the other hand, the

possessor of luminosity, if otherwise palatable, does not seem to escape capture. An examination of the stomachs of fishes makes this clear, except, perhaps, in the case of the herring, which, however, is chiefly a surface fish. Further, it is not evident that such animals are luminous at all times, for it is only under stimulation that many exhibit the phenomenon.

THE FAUNA OF THE ARALO-CASPIAN BASIN.—There is ample evidence that the waters here had formerly a much wider extension, but the exact time, or times, when this occurred—although geologically recent—has yet to be determined. Dr. S. P. Woodward, in his Manual of the Mollusca, says the Aralo-caspian limestone indicates the former presence of a great inland sea—larger than the Mediterranean—at a time previous to that of the Mammoth and the Siberian rhinoceros. This steppe-limestone rises to a level of 200 or 300 feet above the present level of the Caspian.

The fact of the waters of the Caspian and Aral being only brackish, and by no means very salt, leads me to think that the basin has not been a close one for a *very* long period. General von Helmersen found well-preserved specimens of two kinds of shells, viz., *Cardium edule* and *Dreissena polymorpha*, in the sands of the desert of Harakum. Both these species still live in the Caspian. And Helmersen expresses his belief that the entire country from the Aral on to the sandy deserts of Akkum is an old sea-bottom (Quart. Journ. Geol. Soc., 1869, Vol. XXV, Memoirs, p. 8).

The present surface of the Caspian is eighty-four feet below that of the Black sea, and according to Major Wood, a rise of 220 feet would cause the waters of the Caspian to overflow the watershed of the Toboisk, a tributary of the Obi.

According to the same authority, a rise of twenty-three feet in the waters of the Black sea would cause it to overflow into the Caspian by the line of the Manytseh.

From these figures it appears that if the level of the Caspian were to rise (84 × 23) 107 feet, its waters would find their way westward into the Black sea, and if the outlet in that direction were blocked so as to permit the surface of the Caspian to rise 220 feet, the waters would escape northward into the Tobolsk and down the valley of the Obi into the Arctic ocean. Now the Caspian at present contains seals, fishes, Crustacea and Mollusca, some of which are either identical with, or very closely resemble those of the Arctic sea. The seal which inhabits its waters (*Phoca caspica*) is so like the common *P. vitulina* that some naturalists consider it to be a mere variety of that species. There are also the beluga, the sturgeon, the herring, the sterlet, and the salmon, some of which are species that go up rivers from the sea. Among the Crustacea is *Idothea entomon*, found in the Kara sea,

near the mouth of the Obi, and *Mysis relicta*, another northern species. So that there *are* grounds for supposing that some communication may have formerly existed by way of the Obi with the Arctic ocean. No doubt the waters of the Aralo-caspian basin have undergone many changes of level. Some of the mollusca which still live there, such as the Cardium and Dreissena, appear to be descendants of species found in the Congerian beds of that region, which go back to Miocene times.—*T. F. Jamieson in the Geological Magaziue, May, 1885.*

Amœba infesting Sheep.—Sheep in New South Wales are affected by a disease which appears to be very similar to epithelial cancer, and is met with on the feet behind the hoofs, and also on the lips and nostrils and the gums of lambs. The epithelium in these places grows with pathological rapidity, the horny layer produced soon attains a thickness of 3–5$^{mm.}$ the wool drops out in the diseased parts, and below the thick outer layer a festering process sets in. After some time a new epithelium makes its appearance below the festering layer. Then, provided the lamb does not die, the thick horny layer is thrown off like scurf, and the epithelium below attains new wool, and replaces the old skin.

In studying the circumstances in which these sheep live, Dr. R. v. Lendenfeld found that they were invariably exposed to being wounded in those places, which eventually developed the disease, blistered by standing on rocks heated by the sun after they had been standing in water for several hours, or pricked by the spines of the variegated thistle, and it was found by a process of artificial breeding in an aquarium that the disease is produced by an Amœba (*A. parasitica.* n. sp.), which enters the wounds and multiplies rapidly in the epithelium, causing very strong irritation. The organism is found between the layers of horny substance. It does not differ morphologically from the well-known *A. princeps* of Ehrenberg.

Dr. Lendenfeld adds, "It is well known that several fungi in certain stages of their life appear very similar to Amœbæ, and so it is not impossible that my Amœba is in some connection with them. I do not consider this probable, however, as I made no observation which might lead one to suppose that the Amœba ever divided into a multitude of swarming spores."—*Journ. Roy. Micr. Soc., December, 1885.*

Desiccation of Rotifers.—Mr. H. Davis, at a recent meeting of the Quekett Microscopical Club, exhibited some strips of note-paper on which were several groups of dried Philodines (*P. roseola*), looking like clear red spots. These had been sent to Mr. Davis by the Rev. E. T. Holloway, of Clehanger, who had thus succeeded in obtaining specimens of these dried rotifers quite free from sand or dirt of any kind, which has been considered by some to be the only protective.

Dr. C. T. Hudson writes us that "nothing could be more instructive than these curious clusters. In the great majority of cases, each rotifer was seen imbedded in a patch of glutinous secretion, which was divided from the similar patches of the surrounding rotifers by sharp straight lines, so as to give the whole group the appearance of a tesselated pavement. Here and there the Philodines were glued together by long tongues of the same secretion; especially were the fibers of the paper projected above the general surface, and, by spoiling the level, presented the formation of a sharp bounding line. In one case, a rotifer had bored its way into the fibers of the paper, and, unable to withdraw or contract itself, had formed the center of a whole group of others attached to it by radiating bands of glue. In fact, these beautifully clean groups gave ocular demonstration of the truth of Mr. Davis' theory that the Philodines resist drought by encasing themselves in a glutinous case of their own secreting, and the efficiency of the protective was at once shown by putting the strips in water, when the buried rotifers soon struggled into life." —*Journ. Roy. Micr. Soc., February, 1886.*

Parasite of the Rock Oyster.—Mr. W. A. Haskell, on examining some samples of oysters which were dying in large numbers, found that most of them, when opened, presented on the inner surface of the shell one or more discolored blisters. In some these were of small extent with a narrow sinuous form, while in many instances a large part of the valve was affected. In some cases, where the extent of the shell invaded was not large, the oysters did not seem at all affected by it; in other cases the animal was found to be dead, and in a few cases the shell was completely empty. In the interior of the blisters were found one or more specimens of a very small annelid, by which the mischief had been effected—*Polydora ciliata.* One specimen of a second species was also obtained, *P. polybranchia*, n. sp., which the author describes.—*Jour. Roy. Micr. Soc., December, 1885.*

Sense-organs of Copepod Crustacea.—Dr. O. E. Imhof has some notes upon the antennary olfactory organs of the genera Heterocope and Diaptomus.

These appear to have been discovered in Heterocope by Gruber; in Diaptomus they exist in all the species examined, and have a characteristic distribution, which is the same in all the species, and may, perhaps, serve as an additional definition of the genus. The form of the organs in Diaptomus is a little less complicated than in Heterocope; they resemble very closely the corresponding organs of Pontella described by Claus.—*Journ. Roy. Micr. Soc., December, 1885.*

Birds breeding in Ants' Nests.—The Southern chestnut woodpecker (*Micropternus gularis*), always, as far as I have observed, uses an ants' nest to nest in, and Mr. Gammie, the

superintendent of the Government cinchona estates at Mongphoo, near Darjeeling, has noticed the same thing with regard to the allied Northern species, *Micropternus phaloceps*, and the peculiarity probably extends also to the allied species found in Burmah, Siam, &c.

Mr. Gammie thinks that when an ant's nest has been taken possession of by the bird that the ants desert the nest. This is a point on which I cannot speak with certainty. Mr. Gammie has taken nests of the Northern species in which, although the bird had laid, the ants remained, and he has taken other nests where not a single ant remained, but there is nothing to show that these nests were not deserted before the bird took possession. I, myself, have taken nests of the Southern form, in which, though the eggs were partially incubated, the ants remained, showing that some considerable time must have elapsed since the bird took possession. This is a point that I hope to be able to elucidate within the next few months, when the birds will be breeding.

When Micropternus is breeding, the feathers of the head, tail and primaries of the wings are yet covered with a viscid matter, having a strong resinous smell, and this substance is usually rather thickly studded with dead ants (*vide* "Stray Feathers," Vol. VI, p. 145).

Two specimens of kingfishers also to my knowledge nidificate in ants' nests, viz., *Halycon occipitalis*, confined to the Nicobar islands, and *H. chloris*, which ranges from India as far south as Sumatra.

At Mergni, in South Tenasserim, I found a nest of *H. chloris* in a hornet's nest, and although I saw the birds repeatedly enter the hole they had made in the hornet's nest, the hornets did not seem to mind it; but they resented in a very decided manner any attempt to interfere with the nest.—*Wm. Davison, Nature, March 12, 1885.*

The Soaring of Birds.—Mr. Hendricks, in the Naturalist for March, intimates that I misinterpret the phenomenon of soaring, "for it is well known that the upward lateral force would arrest the downward motion, so that the *cause* of the upward motion would be immediately withdrawn."

It would seem that the "downward motion" could only be arrested by resisting the lateral force. On his own showing the gravity of the *body* cannot do it, as this "is descending uniformly through the atmosphere and is therefore meeting with atmospheric resistance equal to its weight" There is no air condensed nor driven out of the way in the lateral motion, so that the only resistance to the lateral force is that of atmospheric friction on the smooth surfaces of the plane, and this is very little.

To enable the weight to resist the lateral force it would have to be created, as the original amount is fully occupied.

As action and reaction are equal and opposite, and normal to the falling surface, the inclination in which that surface lies is a *neutral plane*, and no amount of force acting in that plane can increase or diminish its downward motion.

It is obvious that an incident force at any angle whatever from any direction above the plane would increase the fall, and at any angle or direction from below would diminish it, while in the plane, from any direction, its motion would neither be increased nor diminished but remain unchanged.

There would simply be a motion added to the body, in its own plane, in the direction of the impressed force and proportional to it.

I can detect no "error" arising from "a misconception of the phenomena of resulting motion." The body falls with uniform speed, constituting one of the factors of soaring. It is then moved laterally on an upward incline, which is the other factor. These *result* in the level motion of flight in obedience to the law of all resultant motions.

It seems like a covert attempt on the part of Mr. Hendricks to lodge a perpetual motion scheme with the soaring problem. I am confident that no such fallacy can be domiciled within its precincts.—*I. Lancaster, 335 Wabash avenue, Chicago.*

Zoological News.—*General.*—The deep-water fauna of Lake Leman, if the line between it and the littoral fauna be drawn at thirty metres, at which depth chlorophyll-forming vegetation ceases, consists of about 100 species: Fishes, 14; insects, 3; Arachnida, 19; Crustacea, 16; Hydroidea, 1; Rhizopoda, 13; Cilioflagellata, 1; Gasteropoda, 4; Lamellibranchiata, 2; Annelida, 4; Nematoidea, 3; Cestoidea, 1; Turbellaria, 18; Bryozoa, 1; Rotifera, 2. Most of these are evidently the descendants of the inhabitants of the shallow waters, and differ chiefly in their smaller size and duller tint; but M. Forel maintains that *Niphargus puteanus*, var. *forelii*, and *Asellus forelii* are descended from *Niphargus puteanus* and *A. cavaticus* of the wells of Europe, the resemblance being too close to have been arrived at independently.——The Limneas and Chironomus larvæ which inhabit the deep waters of Lake Leman, breathe water instead of air, *i. e.*, the tracheæ of the one and the pulmonary sacs of the other are filled with water. Larvæ of the dipterous insects abound, but pupæ are rare or absent, and perfect insects are never seen to rise from the surface of the deeper parts of the lake; moreover, larvæ of all sizes and ages are found at the bottom at the same season. This makes it probable that these larvæ never attain the perfect stage, but are capable of reproduction by pædogenesis.

Mammalia.—Carnivora are still common in the north of Europe. The "Statistical Year Book" for Finland states that in 1882 not less than 85 bears, 128 wolves, 407 lynxes, 4005 foxes,

76 gluttons, 240 otters, 143 martens, 1583 ermines and 3947 carnivorous birds were killed and paid for by the Government. The losses during the same year from Carnivora were estimated at 274 horses, 846 cattle, 5246 sheep, 168 pigs, 119 goats, 1681 reindeers and 2366 chickens.

Crustacea.—The Crustacea of the Norwegian North Atlantic Expeditions, excluding forms previously established as belonging to the Norwegian littoral fauna, have been described by G. O. Sars. They comprise: Brachyura, 1 sp.; Anomoura, 1; Caridea, 4; Mysidæ, 5; Cumaceæ, 1; Isopoda, 18; Amphipoda, 45; a copepod, *Eucheta norvegica*, always found at considerable depths, six cirripeds and *Stylon hymenodore*, a rhizocephalon attached parasitically to the abdomen of *Hymenadora glacialis*, and dredged in 1861 fathoms.——*Bythocaris leucopis* and *payeri*, true deep-sea carideans of the North Atlantic (1110 fathoms), do not pass through the usual larval stages, but on quitting, the remarkably large embryos have the full number of appendages found in the parent. *Hymenodora glacialis* has an exopodite attached to the outer side of the second joint of the legs, as in the schizopods. ——*Boreomysis scyphops*, a schizopod taken by the Norwegian North Atlantic expedition has very singular eyes. The outer surface of these organs is concave, they are attached close together, and are destitute of any specific ocular pigment.—— *Sphyrapus serratus* Sars, is a singular sightless isopod which occurs in the open sea between Norway and Iceland, at depths of from 1163 to 1333 fathoms. It has nineteen paired appendages. The first pair of legs springing from the posterior part of the cephalic segment, are powerful prehensile organs. The second pair of legs are as long as the body, flattened, and armed with powerful spines. Five pairs of slender walking feet follow, and are followed by five of biramous swimming feet and a pair of long branched and many-jointed caudal appendages.

EMBRYOLOGY.[1]

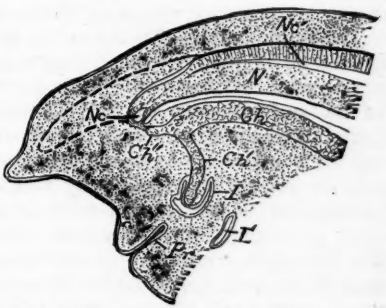
On an Unusual Relation of the Notochord to the Intestine in the Chick.—Through the great kindness of Dr. G. Baur, of the Peabody Museum, New Haven, Conn., I am enabled to figure an apparently rare mode of development of the notochord in the embryo chick. In order to enable the reader to more readily understand the peculiar morphological relations to each other of the posterior ends of the nervous cord, chorda and intestine in the series of sections prepared by Dr. Baur, I have endeavored to combine in one figure what seemed to me to be a correct interpretation of the relations of the parts involved.

The series of sections loaned me and from which I am kindly permitted to figure such portions as are of interest in this connection, were prepared from an embryo of the seventh day. The

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

sections consist of a vertical longitudinal series, which show the structural details represented in the accompanying figure, drawn with the aid of the camera lucida.

The most striking feature is the condition of development presented by the notochord *Ch*, which bifurcates posteriorly into two branches, namely, a ventral one, *Ch'*, and a posterior or dorsal one, *Ch''*. The ventral branch *Ch'* is in close relation to the hindermost portion of the mesenteron *I*, while the posterior or dorsal branch *Ch''*, which really seems to be the posterior continuation of the chorda proper, is closely connected with the under side of the hinder portion of the nervous cord *N*. In fact, there is a readily traceable bridge of tissue between the end of *Ch''* and the under side of *N*, which conclusively demonstrates that these two structures were at an earlier stage continuous. Just above this bridge of tissue there is a cavity, *Nc*, which must in all probability be regarded as a persistent portion of the neurenteric canal, which has been dilated into a vesicle at this point. Certain sections of this series, from a slightly different plane, show that the nervous cord *N* extended back somewhat beyond the point where the notochord joined it, as shown by the dotted outline in the figure. The notochord itself, however, I cannot trace farther back than is shown in the figure, though there are somites developed beyond its termination.



Explanation of Figure.—*Ch*, chorda dorsalis; *Ch'*, portion of chorda developed about the ventral end of the neurenteric canal; *Ch''*, hinder portion of chorda joined posteriorly to the medulla spinalis *N*; *Nc*, vesicular cavity just above the point of union between the medulla spinalis and chorda, and representing a dilatation of the neurenteric canal; *Nc'*, medullary canal; *I* and *I'*, posterior part of mesenteron; *Pr*, proctodæum. × 21.

Judging from what has preceded, it is evident that a connection between the central neural canal *Nc'* and the developing chorda and intestine once existed in this embryo. The central canal *Nc'* is, I believe, traceable to the cavity *Nc* farther back, just below which the neural tube is continuous with the chorda. It seems, in fact, not improbable that the single point of connection between the chorda and nervous cord represents the atrophied neurenteric canal, and that the portion of it which joined the intestine passed down through *Ch''* and *Ch'*. Even supposing that the condition of things observed in this particular embryo is not normal, it is easy to conceive that this specimen may represent a palingenetic type of avian development, comparable with such an one as has

been described by Hoffmann[1] in *Anas boschus*, in which the canalis neurentericus is shown (pl. III, fig. 5) to open into the intestine while a canal also extends from it anteriorly into the chorda itself. Such is essentially the arrangement in the specimen here described, except that the chorda has been differentiated along the entire extent of the neurenteric canal.

The arrangement of parts in the more advanced duck embryo figured by Balfour (Comp. Embryol., II, p. 136), is likewise reconcilable with that observed in the preparations made by Dr. Baur. In Balfour's account of the development of this region in the duck, the condition which has persisted in the specimen here under consideration has been described. He says: "The [neurenteric] passage leads obliquely backwards and ventralwards from the hind end of the neural tube into the notochord, where the latter joins the primitive streak. A narrow diverticulum from this passage is continued forwards for a short distance along the axis of the notochord. After traversing the notochord, the passage is continued into a hypoblastic diverticulum, which opens ventrally into the future lumen of the alimentary tract." It is clear from the figure that this must have been the case in the specimen here under consideration; that is, the neurenteric passage about which notochordal tissue was differentiated was continued forward into the chorda, as the latter was folded off from the hypoblast, and that from this passage in the chorda one passing downward to the intestine was given off about which notochordal tissue was also differentiated.

While it is highly probable that this embryo chick displays an archaic development of the chorda, yet the facts are significant, especially when viewed in the light of the interpretations of Ehlers as to the significance of the "*Nebendarm*" in the invertebrates. This specimen shows that what must have been a part of the neurenteric canal during an earlier stage, *i. e.*, *Ch'*, has been actually differentiated into a structure histologically identical with the true axial notochord *Ch.*

This specimen is therefore of great interest, since it demontrates, if we may regard it as representing a palingenetic condition of development, that the chorda dorsalis was primitively in absolute continuity with the intestine (mesenteron) posteriorly, and that there may therefore have been primitive Chordata in which the chorda was usually developed as such, in almost absolute continuity with the alimentary tract.—*John A. Ryder.*

PROFESSOR SELENKA ON THE DEVELOPMENT OF THE OPOSSUM (DIDELPHYS VIRGINIANA). — The following short notice of the recent investigations of Professor Emil Selenka, of Erlangen, on the development of the common opossum, although it has ap-

[1] Die Bildung des Mesoderms, die Anlage der Chorda dorsalis und die Entwickelung des Canalis neurentericus bei Vogelembryonen. Naturk. Verh. der Koninkl. Akad. Wetensch. XXIII, Amsterdam, 1883.

peared some time since in a foreign journal,[1] seems to us of such unusual interest that we render in English the author's text in full as follows:

"For a number of years I have been intending to trace more accurately the development of some marsupial. The study of this archaic group promises to clear up a number of problems which the study of the embryology of placental mammalia has given rise to, but which that study has hitherto not been in a position to solve, such, for example, as the significance of the peculiar mode of development of the germinal layers in the Placentalia, the conversion of the transitory respiratory organs into an apparatus for the nutrition of the embryo, and further, the higher differentiation of certain organs (the brain, auditory apparatus, diaphragm, etc.)—questions, the solution of which may at the same time explain the origin of the Mammalia.

"During my stay in Brazil (there at that time winter), I found that no sexually mature marsupials were to be had, and since I could obtain but little material, and only such as was unsuitable at that, from the zoölogical gardens of Holland and Germany in the course of years, I resolved to attempt to rear these animals at Erlangen.

"More than two years since, I obtained eight young Brazilian opossums, which promised to do well, but all of which died, one after the other, before they were full grown. Last autumn, however, I obtained, through the kind efforts of Mr. Karl Hagenbeck, of Hamburg, a large number of the hardy North American opossum; in a warmed and well-ventilated stable, these animals, which were well fed, survived the winter remarkably well, and all of them, except a few individuals which were suffering from an affection of the liver and spleen, began rutting during the past spring. Seven females furnished within a few weeks about one hundred embryos, representing the greatest range of stages of development. To obtain such favorable results, various methods of artificial interference had to be resorted to, a description of which is not in place here. Nor would I anticipate the complete account which will appear in the course of the present year, so that I shall now only record some observations on the rutting of these animals and the development of the blastodermic vesicle.

"1. In each spermatoblast of the male, two spermatozoa are developed, which, however, remain united for a remarkably long period. The mature spermatozoa, which are taken from the vagina of the female immediately after copulation, are almost all such twin-cells with double flagella; only after some time do they separate as a consequence of the remarkably strong and rapid vibrations of the flagella—they are literally thus torn apart.

"2. The rutting period of the female occurs at night and dur-

[1] Ueber die Entwickelung des Opossums (*Didelphys virginiana*). Biolog. Centralblatt, v, No. 10, 1885, pp. 294–295.

ing the morning hours and lasts only half a day. If copulation does not take place during this period, the female may rut again in the course of several weeks. Such females also from which the young are prematurely removed from the pouch or marsupium, allow themselves to soon again become pregnant. During the rutting period the walls of the uterus thicken very perceptibly, and principally because of the enlargement of the uterine lymph-spaces, in which the uterine glands then appear to be suspended and to float.

"3. The fertilization of the eggs always occurs five days after copulation and at the lower end of the oviduct, where the latter widens into the uterus. In the vermicularly bent oviducts no spermotozoa are encountered.

"4. Gestation lasts for exactly eight days; then thirteen days after copulation the young are transferred to the marsupium. Development accordingly proceeds with extraordinary rapidity. Only three days before birth do the amniotic folds close over the back of the embryo.

"5. The egg is intermediate in character between the meroblastic and holoblastic type. During segmentation, there is aggregated at the aplastic pole of the egg a nutritive yolk, which at first lies quite outside of the ectoderm, though three days later the neighboring ecto- and mesodermal cells grow over the yolk, which thus becomes surrounded or imbedded by them, but the yolk is never included by the umbilical vesicle (intestinal or entodermal cavity)! Remnants of the yolk persist up to the third day before birth.

"6. The fertilized but unsegmented egg measures almost $.5^{mm}$ in diameter; in the course of twenty-four hours the blastodermic vesicle measures 1^{mm}; in thirty-six hours 1.5^{mm}; in sixty hours 4^{mm}; in seventy-two hours 8^{mm}; in ninety-six hours 14^{mm}, and on the sixth day after the commencement of segmentation as much as 20^{mm} in diameter.

"7. The blastodermic vesicles at first lie quite free and scattered in the uterus; on the fourth day (after the beginning of segmentation), the blastodermic vesicle over the germinal area becomes very loosely adherent to the uterine epithelium.

"8. In the marsupium of the mother there were never more than six young observed. But the number of embryos [found in the uterus] is invariably much greater and varies, according to the size and strength of the female, from nine to twenty-seven."

PHYSIOLOGY.[1]

THE ACTION OF SULPHATE OF SPARTEINE ON THE HEART.—The alkaloid sparteine was discovered by Stenhouse in *Spartium scoparium*, a species of Genista, in 1850. It is a bitter liquid, insoluble in water. Treated with an excess of sulphuric acid, it forms a

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

salt which crystallizes, and dissolves readily in water. M. Sée has made clinical observations with the use of this drug and, according to his results, it is of most extraordinary value in the treatment of various forms of cardiac trouble. Doses of 0.1 gramme of the sulphate of sparteine when given to a patient produced no disturbance of the digestive or nervous system; its effects seemed to be limited to the heart. In fibrous cardiac degeneration a single dose rendered the pulse-tracing normal for the period of three or four days. In irregular rhythm of the heart-beat due to insufficiency of the auriculo-ventricular valves or to contraction of their orifices, the drug brings back the normal rhythm. Three results follow the exhibition of sulphate of sparteine: 1. Its restorative effects upon heart and pulse; in this respect it equals digitalis, and its tonic action is very much more prompt, pronounced and lasting. 2. As a regulator of the rhythm of heart-beat, it stands unrivaled. 3. It causes acceleration of the pulse, and approaches belladonna in usefulness where need of the latter drug is indicated.—*Comptes Rendus, T. ci, p. 1046.*

The Microbe of Hydrophobia.—M. Fol has found in sections of the spinal cord and brain of animals dead from rabies, a micrococcus which he thinks is peculiar to that disease, and probably its etiological factor. The fresh tissue is hardened in a solution of 2.5 per cent bichromate of potash, and 1 per cent sulphate of copper, and the sections are stained with hæmatoxylin. The micrococci are lodged usually in the neuroglia, but more rarely in the nerve-fibers themselves. An artificial culture of the micrococci in healthy cerebro-spinal fluid produced characteristic hydrophobic symptoms in animals which received injections of it in the brain. —*Comptes Rendus, T. ci, p. 1276.*

The Transformation of Peptones by the Liver, and the relation of the Sugar in the Blood to the Nature of the Food Supply.—As previously reported in these pages, Professor J. Seegen, of Vienna, undertakes to prove that the peptones absorbed from the alimentary canal are destroyed in the liver, giving rise to sugar as one of the products of decomposition. If this hypothesis be correct, we must expect that some other body containing the nitrogen of the peptones must be formed at equal rate with the sugar. It was to establish this fact that Seegen's later work was undertaken. The following method was finally adopted as likely to give results most free from error: Two pieces were cut from the liver of a dog just killed, weighed and finely minced. The portions were placed in two glass vessels containing from 50 to 100^{cc} of defibrinated blood from the same dog. To the blood in one of the vessels a peptone solution was added, and to the other a like volume of pure water. By means of aspirators a stream of air was passed through each vessel for the period of three to five hours. At the end of that time a given quantity of

blood was drawn from each vessel, all albuminous matters were precipitated with great care, and the fluid remaining was tested, after concentration, as to its content of nitrogen. The author discusses fully various methods employed in the separation of minute quantities of albuminous substances from complex mixtures. The results of these experiments indicate a very considerable destruction of peptone by the liver with the formation of a corresponding amount of a nitrogenous product of the decomposition.

Seegen was led to the choice of peptone in his study from the fact that Schmidt-Mülheim had found that most of the albuminous bodies digested in the stomach were changed to peptones, and because the researches of Plosz and Gyergyai had showed that the blood of the hepatic vein contained but traces of peptones, while that of the mesenteric veins was rich in them, the conclusion being that the liver was the principal seat of the destruction of peptones. In respect to the formation from peptones of carbohydrates by the liver, the author found that, in experiments performed in the manner described above, not only was the sugar content of the peptone-liver-blood increased 20-70 per cent above the liver blood without peptone, but the total amount of carbohydrates was increased as well. The conclusion is reached that the function of the peptones, at least in carnivorous animals which are not changing in weight, is, for the most part, to give rise to the formation of sugar in the liver.

In another article the same author discusses the influence of variation and nature of the food supply on the presence of sugar in the blood. In the hungering animal (dog), the blood of the hepatic vein is constantly richer in sugar than that of the portal vein, the relative amounts being nearly two to one. The formation of sugar is, then, a continuous function of the liver. Calculation shows that it is hardly possible that this sugar formed during hunger could have come from previously stored carbohydrates. When an animal is fed on food rich in starch, the sugar content of the portal-vein blood is only very rarely increased; the large amount of sugar in the hepatic vein cannot therefore owe its existence directly to sugar entering the liver.

The percentage of sugar in arterial blood is nearly constant in the various conditions of hunger, or when the animal is fed upon starch, dextrine or sugar; the blood from the carotid artery, however, holds a slightly greater amount of sugar during the hours when sugar is being most rapidly absorbed from the alimentary canal.

The blood of the portal vein contains the same percentage of sugar on a starch diet as in hunger, but the sugar content increases when sugar is taken in the food, and to a still greater extent when a mixture of sugar and dextrine is eaten. The blood of the hepatic vein always contains a larger percentage of sugar

than that of the portal vein, not only during hunger, but after all manner of carbohydrate diet. The formation of sugar in the liver has nothing to do with the sugar ingested with the food. The formation of sugar by the liver persists throughout a prolonged period of inanition, and is not increased when a large amount of carbohydrate is fed to the animal. Seegen does not believe that the glycogen found normally in the liver is the source of the sugar of the hepatic vein; it probably has some special destiny, perhaps the formation of fat. The amount of glycogen found in the liver stands in very close relation to the amount of carbohydrate in the food.—*Pflüger's Archiv., 1885, pp. 325 and 348.*

PLETHYSMOGRAPHIC AND VASO-MOTOR EXPERIMENTS WITH FROGS.—Dr. Ellis has followed Drs. Bowditch and Warren in a series of investigations which bids fair to open the way to much that is new and valuable concerning the vaso-motor mechanism. The latter observers studied by the graphic method the variations of volume produced in the hind leg of a curarised cat by electrical stimulation of the sciatic nerve. The volume of the limb was measured by the plethysmograph, and any fluctuations in it could only be due to variation in the amount of blood supply. The authors found when the peripheral end of the nerve was excited by rapidly repeated induction shocks (16–64 per sec.), there was usually contraction of the vessels. When a slower rate was employed (4–0.2 per sec.), there was dilatation. With a medium rate of stimulation there followed first a narrowing and afterward a dilatation. A latent period of 1.5 sec. preceded the constriction, and one of 3.5 sec. the dilatation. The latter effect sometimes persisted for several minutes after cessation of the stimulation, but the former usually ceased with it.

By an exceedingly ingenious application of a test-tube plethysmograph connected with very delicate registering tambours, Dr. Ellis has been able to study the vaso-motor changes produced in the leg of curarised frogs by stimulation of the sciatic nerve. The general results agree very well with those already obtained on the cat. In general, slow interruptions (1 or 2 per sec.) caused dilatation, while rapid stimulation (15 per sec.) caused contraction. The author remarks: "In studying the varying effects of electrical stimulation upon the blood-vessels, several factors must be considered. 1. *The intensity of the induction shocks.* The greater the intensity of the shocks, other conditions remaining the same, the greater the tendency to immediate contraction on the part of the blood-vessels. The converse of this is in a measure true, namely, the weaker the stimulus, the greater the tendency to immediate dilatation. 2. *The number of induction shocks per second.* The greater the number of shocks per second, the greater the liability to contraction, and conversely. 3. *Duration of the stimulation.* The longer a series

of weak shocks rapidly following one another is applied, the more likely is it to cause contraction."

The intensity of the slowly repeated shocks which produced dilatation, was usually much greater than that of the rapid stimulation which caused constriction; but when the total stimulations to which the nerve is subjected, obtained by multiplying the intensity of each shock by the number of shocks applied, are compared in the two cases, it is found that when dilatation is obtained, the total stimulation is much less than when constriction is caused. These experiments indicate the existence of two separate peripheral vaso-motor mechanisms, one having the function of vaso-constriction, and the other of vaso-dilation.—*The Journal of Physiology, Vol. vi, p. 437.*

PSYCHOLOGY.

ANTHROPOLOGY AND PSYCHOLOGY.—At the Aberdeen meeting of the British Association for the Advancement of Science, Dr. Alexander Bain, lord rector of Aberdeen University, read a paper "On the scope of anthropology, and its relation to the science of mind." He endeavored to point out that the bringing together of the six departments—named respectively man's place in nature, the origin of man, the classification of races, the antiquity of man, language and the development of civilization—did not contribute to the mutual elucidation of the several topics, but merely concentrated into a whole the subjects connected with the higher mysteries of man's origin and destination. He next dealt at length with a survey of the researches having in view precise measurements of the bodily and mental characteristics of human beings, and indicated lines on which research might be made so as to reflect new light on our intellectual constitution. The author also reverted to the research into the conditions and the measure of memory as wholly within the means of actual experimental determination; also the important intellectual function of seeing similarity in the midst of diversity, which can be reduced to more or less precision of estimate by suitable means. Taking along with these results the inquiries into the faculties of the lower animals, the author put special stress on the number and delicacy of their senses as the foundation of every attempt to explain the higher aptitudes. Intelligence commenced with the power of discrimination, and increased as that power increased. The record of marvelous feats of exceptional ingenuity was of very little aid in revealing the secrets of the animal mind. In conclusion, he urged the admission of psychology in a more avowed and systematic form into the anthropological section. He would exclude the topics of metaphysical and ethical controversy, and welcome all the researches into the intellectual and emotional regions of the mind. Dr. Burdon Sanderson said any one teaching physiology would not be expected to include anthropology, and Dr.

Bain had shown why it was not done. That was because when we came to the higher functions of man, called mental functions, we had to do with perceptions which were founded upon sensation, which meant interpretations by the mind of those perceptions. He considered that the line at which physiologists stopped was the line at which Dr. Bain begins—namely, measure. He heartily agreed with Dr. Bain in thinking that psychology is the subject that lies at the basis of anthropology, and should be accepted as its foundation.

PHILADELPHIA BRANCH AMERICAN SOCIETY FOR PSYCHICAL RESEARCH.—The Philadelphia Branch of the American Society for Psychical Research holds meetings monthly. It has organized with committees on thought transference, hypnotism and spiritualistic phenomena, and entered upon the lines of collective investigation, followed by both the American and British societies. The committee on thought transference has collected the results of some twelve thousand experiments conducted by a number of observers, and a statistical study of these seems to show a slight preponderance of right guesses when the conditions are such as render thought transference possible.

A special committee has been inquiring into the subject of faith-cure; but without attaining anything in the way of positive results. Some of the most frequently described cases of marvelous cures were, on investigation, found to be without any sufficient basis in fact. In general, the "faith-curists" seemed to dread and abhor anything like a scientific investigations of their claims; so that any careful study of the psychic phenomena which attend the cure of even those nervous and illusive maladies that are known to be amenable to mental impressions, was out of the question. Other standing and special committees will report at the regular meetings of the branch.

ANTHROPOLOGY.[1]

MAORI PHARMACOPŒIA.—Mr. Kerry Nichols has preserved for us in the Journal of the Anthrop. Inst. (xv, 206) the native medicines of the Maoris of New Zealand:

Harakehe (*Phormium tenax*), New Zealand flax, decoction of leaves and root used for *paipai*, a cutaneous disease.

Horopito, a shrub, decoction of leaves used for *paipai*.

Huhu, a grub found in the *rimu* (*Dacrydium cupressinum*), *matai* (*Podocarpus spicata*) and *kahikatea* (*Podocarpus dacrydioides*), eaten as medicine.

Kahikatea (*Podocarpus dacrydioides*), decoction of leaves used for internal complaints.

Kareas (*Phipogonum scandens*) decoction of roots used as sarsaparilla, young shoots eaten for itch.

Kawakawa (*Piper excelsum*), leaf used for the *paipai*, and to heal cuts and wounds.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

Kohekohe, a powerful tonic; a weak infusion of the leaves stops the secretion of milk.

Kohukohu, a lichen, when dried and reduced to powder is applied to cutaneous eruptions.

Kokakapa (Trichomanes), the leaf is used to heal ulcers.

Koromiko (*Veronica sulcifolia*), an infusion of the leaves is a powerful astringent; a weak infusion a tonic; the leaves are applied as a poultice for ulcers; a decoction of the leaves is valuable in dysentery; a small portion of the leaf, if chewed, soon produces a keen sense of hunger.

Mamahu (*Cyanthea medullaris*), the bruised pith is used as a poultice for sore eyes.

Miro (*Podocarpus ferruginea*), a weak infusion of the bark is taken for stomach ache.

Mouku, an edible fern; a wash obtained from the root is good for sore eyes.

Ngareku, charcoal powdered fine, is used for cutaneous diseases.

Papanuga, the infused bark is drunk for the *hakihaki*.

Papa-auma, or mistletoe, the bruised bark is applied for the itch by rubbing it over the skin.

Paretau (*Asplenium oblequum*), a large-leaved fern, the root is used for *paipai*.

Patete, the sap is used for scrofulous sores and ringworm.

Pohutakawa (*Metrosideros toamentosa*), an infusion of the inner bark is used for diarrhœa.

Pukatea (*Atherosperma novæ zelandiæ*), the bark is used for scrofulous sores.

Raorao (*Pteris esculenta*), tender shoots used for dysentery.

Rata (*Metrosideros robusta*), infusion of bark used for dysentery.

Rauriki, or sow-thistle, an infusion is used for stomach complaints.

Rimu (*Dacrydium cupressinum*), an infusion used to heal running ulcers.

Tawa (*Nesodaphne tawa*), bark used for stomach aches and colds.

Ti (*Cordyline australis*), an infusion of the leaves used for dysentery.

Taotao (*Phyllocladus trichomanoides*), leaves used for scrofulous diseases.

Tutu (*Coriaria ruscifolia*), tender shoots, when plucked at certain seasons, are taken for dysentery.

THE LAPLANDERS.—In Journal of Anthrop. Inst., XV, will be be found communications from Prince Roland Bonaparte, Dr. J. G. Garson and Professor A. H. Keane respectively, upon the Lapps, that of the latter being very full. There are, at present, 25,367 Lapps, although at least 7000 are of mixed Finnish blood. They are divided into upland or nomadic, and lowland or fishing and agricultural divisions. Their name is involved in obscurity, the people call themselves Samé, "Fenmen," Finlanders. They would appear to be an offshoot of the great Finno-Tartaric (Malo-Altaic) family. They are brachycephalic (80° to 83° 50′), short in stature (five feet and less), with brown hair, flushed complexion, brown eyes, straight and regular nose.

The upland Lapp's life is dependent on the reindeer, whose "flesh being mostly dried is converted into jerked meat, whose offal is boiled and eaten fresh, whose blood is congealed, pulverized and kneaded into cakes or used as soup; the milk taken fresh or frozen in a slightly fermented state, or made into cheese for winter store. The skin covers the tent floor, the bed and the body; the sinews make excellent cordage, and the bones, after extraction of the marrow, are carved into many useful and fanci-

ful articles." The herds range in number from 100 to 2000 and upwards.

There are two classes of these nomads, those who remain with their herds during the year, and those who from May to August leave their flocks and take to fishing. The Lapp is assisted in the care of his herd by a very intelligent race of dogs. The sledges are of three kinds:

Kerres, in which the traveler sits as in a boat.
Lakkek, for freight, decked over.
Pulkan, sledge proper, half covered, used on important occasions.

The snow shoes are six to seven feet long and three and a half to four inches wide, used either in walking or when the owner is drawn by reindeer.

Mr. Keane closes his deeply interesting paper with references to the social life, the religion and the language of the Lapps.

Dr. Garson gives a close anthropometric description of a family of Lapps exhibiting in London.

RELATIONSHIPS BETWEEN ESKIMO TRIBES.—Dr. Rink gives a short paper in Journal of the Anthrop. Inst. on the relationship of the Eskimo tribes as determined by dialects. The following table illustrates the order of thought:

ABORIGINAL INLAND ESKIMO.

Principal stem. Eskimo proper.			Side branch. Aleutians.
Eastern.			V. Western.
III. Middle regions. Iglulik, Repulse bay, Churchill.	IV. Mackenzie.		Northern. 1. Pt. Barrow. 2. Kaviagmut. 3. Malemut. 4. Unaligmut. 5. Ekogmut. 9. Asiatics.
I. Greenlanders.	II. Labradorians.		Southern. 6. Tschugazzes. 7. Kadjagians. 8. Kangeugdlit.

ARCHÆOLOGICAL MAP.—The Numismatic and Antiquarian Society of Philadelphia has undertaken the preparation of an archæological map to embrace the valleys of the Delaware and Susquehanna rivers. This map is intended to show the location of all the principal remains attributed to the Indian tribes who formerly occupied these regions, including the contiguous portions of Pennsylvania, New York, New Jersey, Delaware and Maryland. Accurate information is solicited concerning Palæolithic gravel deposits, artificial shell-heaps, cave-retreats, encampments or village sites, earthworks, old fields, quarries, workshops, surface deposits of implements (caches), large rocks in place used as mortars, rock inscriptions (in situ), burial places, tumuli or mounds, Indian trails. The circular of the society is signed by Edwin A.

Barber, John R. Baker, Henry Phillips, Jr., Francis Jordan, Jr., Stewart Culin, Daniel G. Brinton. Communications should be addressed to Henry Phillips, Jr., No. 104 S. Fifth street, Philadelphia. The society is to be congratulated for its energy in this matter. The City of Brotherly Love was once headquarters of anthropology in America.

THE REVUE D'ANTHROPOLOGIE.—The most celebrated of the many French journals devoted to the science of man, was founded in Paris by Paul Broca, in 1872, and continued by his pupil, Dr. Paul Topinard, after the death of the former. A third series was commenced with 1886 with the coöperation of the most distinguished representatives of the various branches of anthropological science; among them Dr. Gavarret, director of the Ecole d'Anthropologie de Paris; Dr. Mathias Duval, director of the Laboratoire d'Anthropologie a l'Ecole des Hautes Etudes; Marquis de Nadaillac; General Faidherbe, High Chancellor of the Legion of Honor; Professor A. de Quatrefages, at the Museum of Natural History; Dr. Hamy, of the Musée Trocadero; L. Rousselet; Jules Rochard; Baron Savoy and D'Arbois de Jubainville, of the French Institute. Dr. Topenard, the director of the Revue, is general secretary of the Société d'Anthropologie de Paris, and author of the Eléments d'Anthropologie, to which the Académie des Sciences, awarded one of its annual prizes.

THE RACES OF MEN.—The latest attempt to find a rational expression of racial differences among mankind is by Mr. James Dallas, curator of the Albert Memorial Museum, Exeter. The author is in accord with the general tendency to see three principal groups of humanity, as follows:

Leucochroi, represented by the European.
Mesochroi, represented by Mongols and American Indians.
Æthochroi, represented by Negroes and Australians.

In the Æthochroic group, Mr. Dallas would include Berbers, Nubians. Even admitting that this type extended into Arabia, there would still be an enormous gap between this and the nearest Eastern appearance of the Æthochroic group in India. The Kuhlis, Bhils, Gonds and Konds of India; Mincopies, of Andaman; the Negritos and Samangs of the Philippines, and the Malay archipelago; the Papuans and other pelagian negroes; the Australians and Tasmanians all belong, according to the author, to one great type.

Although the Æthochroic group is spread over an immense area, "the changes in physical geography requisite to bring all these into communication are far from great. An elevation of one hundred fathoms would join all the islands from Cochin China to Java, including Borneo; New Guinea would be joined to Australia, and the narrow seas which would exist between the remaining islands would offer no great barrier to the migration

of man. A yet greater elevation would convert the Bay of Bengal into dry land, join the Andamans to India, the Laccadive and Maldive islands to Arabia, converting the Arabian sea into a broad expanse of nearly level ground." At the same time a great geological barrier would be erected against the northern movement of this type. "Thus we have an area to no small extent demonstrably cut off from the northern regions of Asia and Europe, in which alone traces of the Æthochroic group are to be met with, and the Æthochroic peoples were originally the sole occupiers of this area." Mr. Dallas relies largely upon facts connected with the distribution of apes and other mammals to bear him out in his views regarding the spread of the Æthochroi. As regards the purity of this group it is supposed that two developments, one in Africa, the other in the Philippines and Andamans, almost pure, still exist. In the other areas the stock is much mixed.

Roughly speaking, the Leucochroic group occupies the whole of Europe with the exception of a part of the northern portion, and parts of Hungary and Russia. Eastward, members of this group exist in the Caucasus, Armenia, Persia, Georgia, Circassia, Afghanistan, Kashmir, and Hindustan, Kattiwar and Rajputana, and include the Siah Posh Kafirs of the Indian Caucasus, and remnants in China, Tartary, Japan, Kurile island and Kamtshatka. Indeed, Mr. Dallas looks for the origin of this type in the heart of what is now the Mongol area, the plateau of Central Asia, believing that they extended along the eastern coast of Asia from Kamtshatka on the north to the limits of the Æthochroi on the south. From this central region the Leucochroic race passed westward by the great depression, the Zungarian strait, to overrun first Western Asia, and eventually the whole of Europe, branches being thrown out wherever geographical confirmations offered the way. In this distribution the wolf, otter, sheep, mole and marmot are taken as parallels among mammals. The Aino and the Gothic races are assumed to be tolerably pure examples of this stock.

The Mesochroi occupy the two Americas, the whole extent of the eastern shores of Asia from Kamtshatka to Siam, and thence stretch westward to the Bay of Bengal. North of the Himalayas they occupy the original seat of the Leucochroic group, and thence spread over Western Asia, following the route formerly taken by the Leucochroi. The Malays, Polynesians, Lapps, Fins and Basks are relegated also to this type. The original center of distribution and the lines of march in this group are less intelligible. The extinct rhinoceros is taken as the parallel in migration. Intimations are also given that the course of population was from Europe to America, and thence to Asia.—*Journal Anthropological Institute, xv, 304.*

ANTHROPOLOGICAL NEWS.—A German treatise of Ernst Kuhn "on the origin and languages of the transgangetic nations" was published in the Transactions of the Bavarian Royal Academy (1883, pp. 22, 4to), and gives a lucid sketch of racial and linguistic facts observed in China and Indo-China by recent investigators. Kuhn thinks that the autochthonic population of the Indo-Chinese peninsula are the people of Annam, Kambodja and Pegu, and that the intruders who drove them to the coast, came originally from Western China, like the Tibetans; that the monosyllabism of all these languages is not original, but only the result of condensation of a former polysyllabic status; that the Tibetan language has retained the most Arabic forms of the western group of dialects; that the Kambodja is not a Malayan language, as it has been asserted by Aymonier and Keane; that the series of numerals proves ancient affinity of Chinese with Barma (Burmese), Siamese, Lepcha and Tibetan. —— The Lord's Prayer, translated by E. H. Man into the South Andamanese language, has been fully commented by R. C. Temple, and edited by him with a scientific preface and introduction on that curious agglutinative language, which had never been previously investigated in a philosophic manner.——The interpretation of the local names of Celtic origin in France, Germany and Italy forms a *crux interpretum* of a peculiar kind for local etymologists, for the simple reason that the ancient Celto-Gallic language and its dialects is almost entirely lost to us. It has been preserved in about twenty or thirty short inscriptions only, which are very differently translated by the scientists, and in a considerable number of personal, tribal and local names, most of which are just as enigmatic as the above inscriptions. The coeval languages of the Greeks and Romans, Oscans and Umbrians being of the same linguistic family, some light is thrown upon the Celtic from that quarter. Dr. Quirinus Esser, inspector of schools at Malmedy, Prussia, has brought to bear all the resources of modern linguistics upon the elucidation of these local names of Middle Europe, as Ruhr, Rezat, Gürzenich, Kanzach, Créteil, Doubs, &c., through the historical method, in his Beiträge zur gallo-keltischen Namenkunde, Malmedy, 1884, pp. 128. Another series of local names, Celtic and Romanic, were learnedly investigated by the same author in a series of articles published in the *Kreisblatt für Malmedy*, at St. Vith, the county seat.—*A. S. Gatschet.*

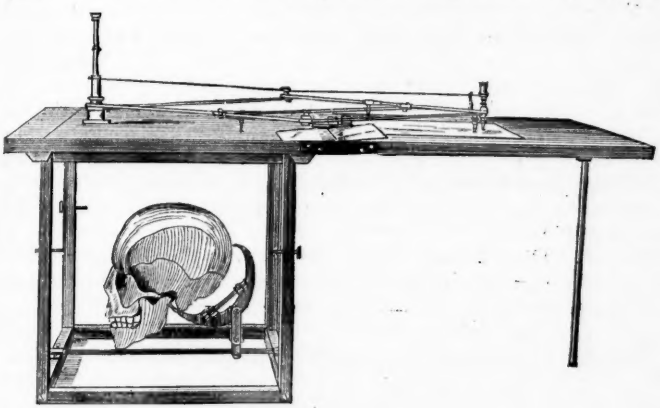
MICROSCOPY.[1]

THE DIOPTROGRAPH.[2] — The dioptrograph is a mechanical drawing apparatus adapted to drawing the outlines of macroscopic objects. It consists of a pantograph (in which the tracer is represented by a tubular diopter) supported on a square table.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] F. Kinkelin, Humboldt, I, Part 5.

By shifting the position of the diopter (sight vane) on a mirror glass plate, the eye can follow the outlines of the object placed below the glass as they appear at the intersection of the cross-wires contained in the diopter. The table is supported by four square wood frames which together bound a cubical area, as shown in the figure. A pane of glass, fitted with a frame, represents the upper surface of the cube, while the five other sides are open so as to admit of the frame with the plate being placed upon any side of the cube. On the lower frame Schroeder's steel pincers are fitted, by means of which the object may be placed in such a position as to be completely detached and visible from all sides. These pincers firmly grasp the object; this is effected by fastening a screw and by three sharp points. The axis of the pincers has a bilateral clamping movement, which may be regu-



lated by means of a screw; then there is a round bar fixed on two opposite sides of the lower frame, on which a vertical rotation of the axis of the pincers and a horizontal sliding movement of the object can take place. Lastly there is a conical pin, adjustable by means of a special screw and admitting of a horizontal rotation of the object. The drawing-board, which is connected with the table by means of hinges, can be folded down upon the glass plate of the table.

In the figure the pantograph, consisting of the diopter and pencil connected by a frame-work for mechanical adjustment, is represented in position for drawing. The drawings may be made of natural size, or they may be enlarged or reduced, according to the proportions required.

For the use of tourists a folding instrument is made. In this instrument objects are placed on three pins, which can be adjusted at the bottom according to requirements.

For the geometric drawing of smaller objects the following appliances are used:

1. One object-plate, which is placed below the glass plate and which, by means of an arm, may be moved up and down on one side of the cube. Upon this plate a small object imbedded in clay or any other suitable substance may be placed.

2. A tubular diopter furnished with a lens.

PRICES.

A. Folding dioptrograph of polished mahogany for tourists.....$70 00
B. Same as A, but not polished and without case..... 55 00
C. Same as A, but not folding (like the figure here given)..... 72 50
D. Same as C, not polished..... 62 50

The instrument is made by Luckhardt & Alten, in Cassel, Germany.

OPALINA.[1]—The life-history of this very interesting parasitic protozoan, and the methods to be employed in tracing it are now very fully known, thanks to the investigations cited below. The subject is one of special interest to the teacher as well as to the investigator, since it illustrates one of the simplest life-cycles known to us, and since the mode of development and propagation rises somewhat higher than in typical unicellular Protozoa.

Habitat.—Hind-gut of batrachians (also found in planarians and Naideæ).

Period of reproduction.—Early spring, beginning as soon as the host leaves its winter quarters for the open water, and continuing only a few weeks in some species, while lasting for two to three months in others.

Mode of reproduction.—Longitudinal and transverse fission. The adult polynucleated Opalina (*O. caudata* and *O. similis* have generally two nuclei, and occasionally only one) splits up by successive divisions into a large number of parts, each containing, according to the species, one or more nuclei. These parts encyst while in the hind-gut of the host, and are then dropped with the fæces into the water. The spherical cysts (.025-.03^{mm}) remain unchanged for several weeks on the bottom, and only begin their development after being swallowed by young tadpoles and passing into the hind-gut.

Material.—The adult Opalina may be easily obtained by cutting out the hind-gut of a frog and pressing a little of the contents of

[1] Th. W. Engelmann. Ueber Entwickelung u. Fortpflanzung von Infusorien. Morph. Jahrb., I, p. 573, 1875.

Ernst Zeller. Untersuchungen über die Fortpflanzung und die Entwickelung der in unseren Batrachiern schmarotzenden Opalinen. Zeitschr. f. wiss. Zool., XXIX, p. 352, 1877.

Wilh. Pfitzner. Zur Kenntnis der Kerntheilung bei den Protozoen. Morph. Jahrb., XI, H. 3, p. 454, 1885.

Moritz Nussbaum. Ueber die Theilbarkeit der lebendigen Materie. Arch. f. Mik. Anat., XXVI, pp. 487, 509 and 514, Jan., 1886.

the anterior end into a drop of water on a slide. If this is done in early spring, all the phases of fissiparism may be obtained, together with encysted stages. The best time, however, for studying the process of fission is during the winter. If a frog is kept in a warm room twenty-four hours and fed well, it will be found that fission of the Opalinæ, if any are present, has advanced to the point of encysting, and a complete series of stages may be readily obtained.

Material for the study of the development is obtained from young tadpoles (5^{mm} and upwards in length) collected from their natural haunts, or better, raised from the egg and fed with Opalina cysts. A few hundred eggs of the frog may be placed in a small aquarium, and at the same time the fæces from several frogs which are known to contain numerous Opalina cysts. Soon after hatching, the tadpoles will begin to eat water plants and animal and vegetable remains of various sorts found on the bottom, and will thus become infected with Opalina cysts.

Methods of study.—(*A*) The process of reproduction by fission can be followed best by placing fresh specimens in a drop of a very dilute solution of gum arabic and examining without a cover-glass; or, in a drop of humor aqueus from the frog, in which Nussbaum kept them alive, in one case four days. The humor aqueus should be inclosed air-tight.

(*B*) For the study of the caryokinetic multiplication of nuclei, which is the leading feature in the development of multi-nucleate forms, preparations may be made in the following manner:

(1) Press out a portion of the fæces from the anterior end of the rectum on to a slide, adding a drop of water.

(2) Carefully remove, by the aid of fine forceps, all visible pieces of substance, taking special care to leave no grains of sand, and then cover with a very thin cover-slip. The water added should be just enough to fill the space beneath the cover without flowing beyond its edges, and the space as thin as possible in order that the larger Opalina may be under slight pressure.

(3) By means of a brush make a border of picric acid (saturated aqueous solution) all around the cover, and leave the slide thus prepared in a moist chamber for one or two days, giving time for the acid to penetrate slowly and evenly from all sides.

(4) Wash with distilled water until the Opalina are completely colorless, allowing the water to work slowly under from one side of the cover, while it is drawn away with blotting paper from the opposite side. Great care should be taken not to add the water more rapidly than it is drawn away, as the raising of the cover would allow the Opalinæ to float away. The process of washing requires several hours, and must be closely watched from beginning to end.

(5) Stain with Grenacher's alum carmine or hæmatoxylin, drawing a border of the dye around the cover, as was done with

picric acid; then leave in moist chamber for a few hours (hæmatoxylin), or one or more days (alum carmine).

(6) Wash with distilled water, proceeding as in No. 4.

(7) Dehydrate with absolute alcohol, taking care not to disturb the cover, and then add a border of clove oil. The alcohol soon evaporates and is replaced with the clarifying medium. The preparation is now ready for examination. If the preparation is to be preserved permanently the clove oil should be replaced by xylol, and then a thin solution of balsam in xylol allowed to flow under the cover as the xylol evaporates. As a good preparation is often spoiled in the process of mounting, it is well to make the examination in clove oil first.

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SCIENTIFIC NEWS.

— Dr. C. V. Riley, entomologist of the Department of Agriculture and honorary curator of insects in the National Museum, has presented to the National Museum his extensive private collection of North American insects, representing the fruits of his labors in collecting and study for over twenty-five years. His collection contains over 20,000 species, represented by over 115,000 pinned specimens, and much additional material preserved in alcohol or other methods. It is estimated by those familiar with the collection to have a money value of at least $25,000. In addition to the actual cost of material it is hard to estimate the amount of time and labor that such a collection represents. In acknowledging the donation, Professor Baird expresses the warmest appreciation for this most generous gift, and his assurance that both now and in the future it will afford a valuable means of study for the entomologists of this country. This collection is especially rich in Coleoptera and Lepidoptera, and the latter contains many rare larvæ, blown and in alcohol. As it stands, by this gift the entomological collections of the National Museum become next in importance to those at Cambridge.

— The anniversary meeting of the Royal Microscopical Society was held in January, when the president (Dr. Dallinger, F.R.S.) delivered an address dealing with the results he had obtained during the last four years principally in the employment of the greatly improved microscope object-glasses made on the homogeneous-immersion principle. The special research which Dr. Dallinger has been engaged upon, and to which his address was devoted, is the elucidation of the origin, development, division and ultimate function of the nucleus, as found in what may be assumed to be its simplest condition in the more striking of the septic organisms, and his microscopical observations have been chiefly made on the living organism. The object-glasses employed by Dr. Dallinger are high powers of most recent construction, in which the apertures have been carried to the highest

point hitherto attained, and were made expressly for his investigations by Messrs. Powell and Lealand.

— The first number of the Bulletin of the Scientific Laboratories of Denison University, at Granville, Ohio, edited by Professor C. L. Herrick, contains the following articles:

Osteology of the evening grosbeak (*Hesperiphona vespertina* Bonap.), with Plate I and frontispiece, by the editor.

Metamorphosis of phyllopod Crustacea, with Plates V–VIII and Plate X, by the editor.

Superposed buds, with Plate XII, by Aug. F. Foerste, class of '87.

Limicole, or mud-living Crustacea, with Plate IX, by the editor.

Rotifers of America, Part I, with descriptions of a new genus and several new species, with Plates II–IV and Plate X, by the editor.

The Clinton group of Ohio, with descriptions of new species, with Plates XIII and XIV, by Aug. F. Foerste.

A compend of laboratory manipulation, Chapter I, Lithological manipulation, accompanied by a condensed translation of Eugene Hussak's Tables for the determination of rock-forming minerals, by the editor.

The whole forms a volume of 180 pages, with fifteen plates, and affords good evidence of the scientific zeal and energy of the scientific corps of this institution.

— At a recent meeting of the Royal Society, Dr. Downes read a paper on the action of sunlight on micro-organisms, in which he called attention to the fact that the observations made by himself and Mr. T. Blunt, described in papers contributed to the society during 1877–79, had been corroborated by other investigators. Dr. Downes now asserts that the hyperoxidation of protoplasm by sunlight is a general law, from the action of which living organisms are shielded by protective developments of cell wall, coloring matter, &c. In previous communications Dr. Downes had shown that sunlight was fatal to saprophytes, and that in the presence of free oxygen the molecule of oxalic acid might, under the influence of light, be entirely resolved into water and carbonic acid. The alterative ferment of cane sugar, a representative of the diastases, is also oxidized by sunlight.—*English Mechanic.*

— *A question.*—I should be very much obliged to anybody for some information on the following points, regarding Menopoma, Amphiuma, Necturus and Siren:

1. Where are these batrachians common?

2. Has anybody ever seen the eggs and larvæ (embryos) of these forms, and in what season?—*Dr. G. Baur, Yale College Museum, New Haven, Conn.*

— Mr. Mellard Reade's presidential address to the Liverpool Geological Society has been printed in separate form, and will interest geologists. He discusses the way in which the enormous amount of mineral matter poured into the Atlantic is distributed. He concludes that deposits thousands of feet in thickness are being laid down about the mouths of great rivers, forming exten-

sions of the true deltas, and, therefore, what appears to be a submarine prolongation of the margin of a continent may, in many cases, be merely a sedimentary deposit washed down from the interior.

— Dr. Alfredo Dugés writes from Guanajuato, Mexico, that on the 5th of February there fell at that place eight inches of snow. It made a fine appearance, covering the trees full of leaves, and stupefied the inhabitants, most of whom had never seen such a phenomenon. The thermometer fell to 4° and 5° C.

— Jan. 17, died in Strassburg, Professor E. Oscar Schmidt, who was distinguished for his researches on turbellarian worms and sponges, as well as several valuable general works.

— W. T. Thiselton Dyer has succeeded Sir Joseph Hooker as director of Kew gardens.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Feb. 20.—Mr. Romyn Hitchcock, Demonstration of the resolving power of a new 1-16 inch objective; Dr. D. E. Salmon and Dr. Th. Smith, On a new method of producing immunity from contagious diseases; Dr. C. V. Riley, A carnivorous butterfly larva; Mr. Lester F. Ward, The plane tree and its ancestors; Dr. C. Hart Merriam, Contributions to North American mammalogy. II. Description of a new species of Aplodontia; Dr. George Vasey, New and recent species of North American grasses.

New York Academy of Sciences.—I. A new electric winding apparatus for clocks (illustrated); II. On the need of a normal time-system for observatories, Professor John K. Rees.

March 1.—Mrs. Alice D. Le Plongeon read an address on Yucatan, its ancient temples and palaces. The paper was illustrated with numerous lantern photographs, taken by Dr. and Madame Le Plongeon, during twelve years of study and exploration among the remarkable monuments and scenery of Yucatan.

Boston Society of Natural History, Feb. 17.—Dr. W. G. Farlow spoke of the collection of lichens recently presented to the society by Charles J. Sprague, Esq.,; and Mr. S. H. Scudder discussed the best methods for arranging and classifying the libraries of natural history institutions.

March 3.—Dr. Thomas Dwight read a paper on the significance of the internal structure of bone, illustrated by the stereopticon.

Appalachian Mountain Club, Feb. 10.—An ascent of the Matterhorn, by Melancthon M. Hurd; The Carter-Moriah path and camp, by W. G. Nowell; An exploration of the Pilot range, by W. H. Peck.

Feb. 17.—Major Jed. Hotchkiss addressed the club on Mount Rogers, the highest point of the Appalachians in Virginia.